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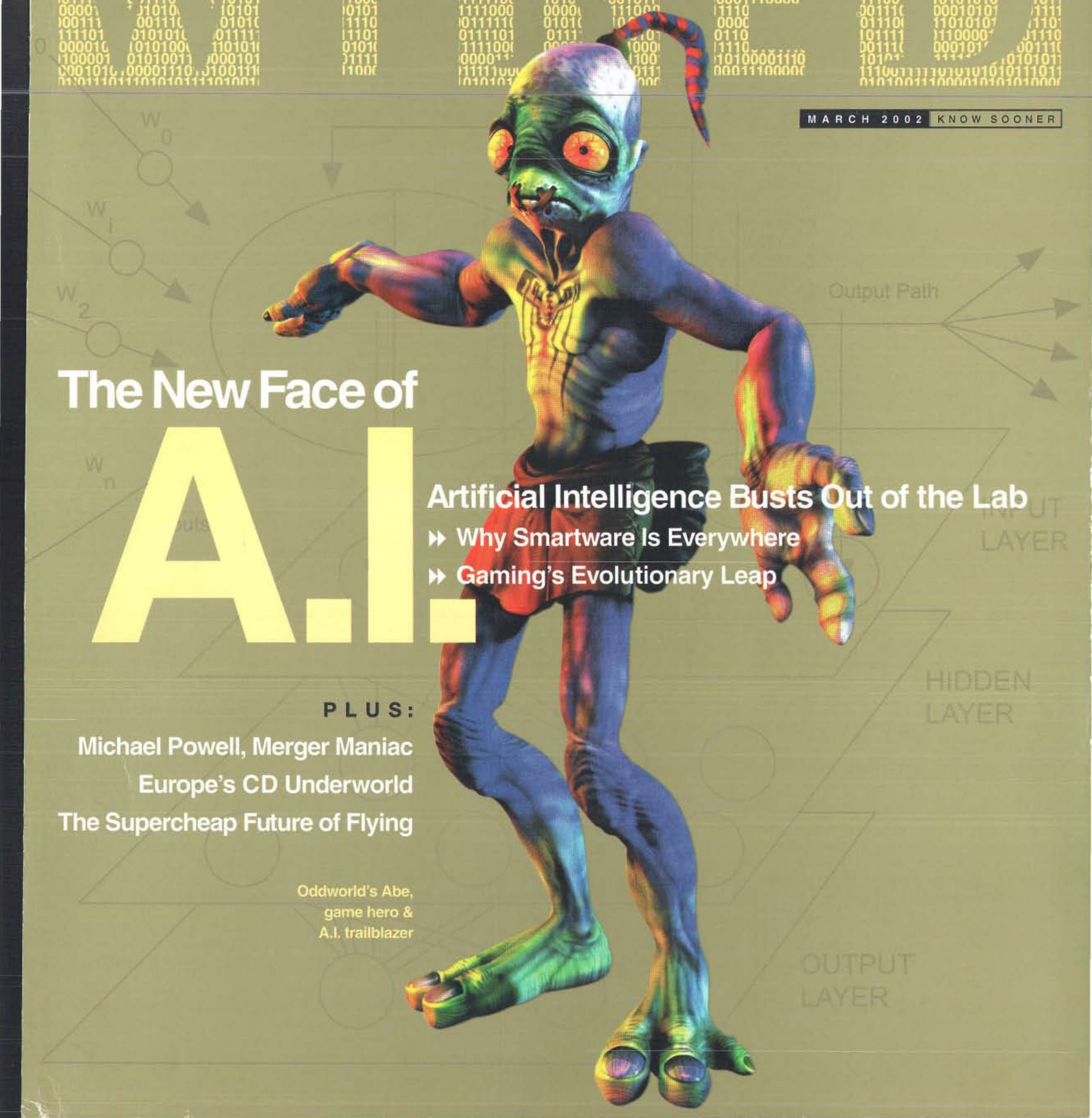

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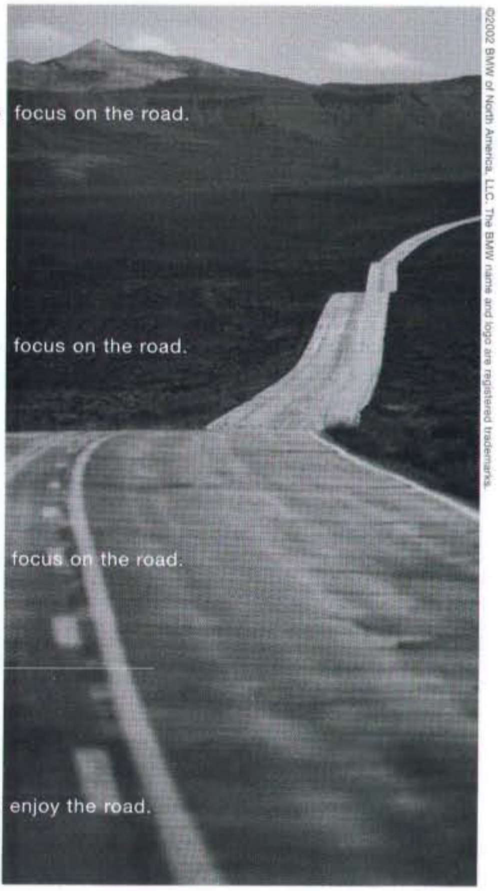

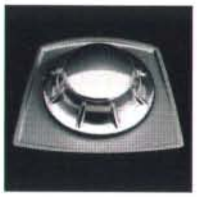

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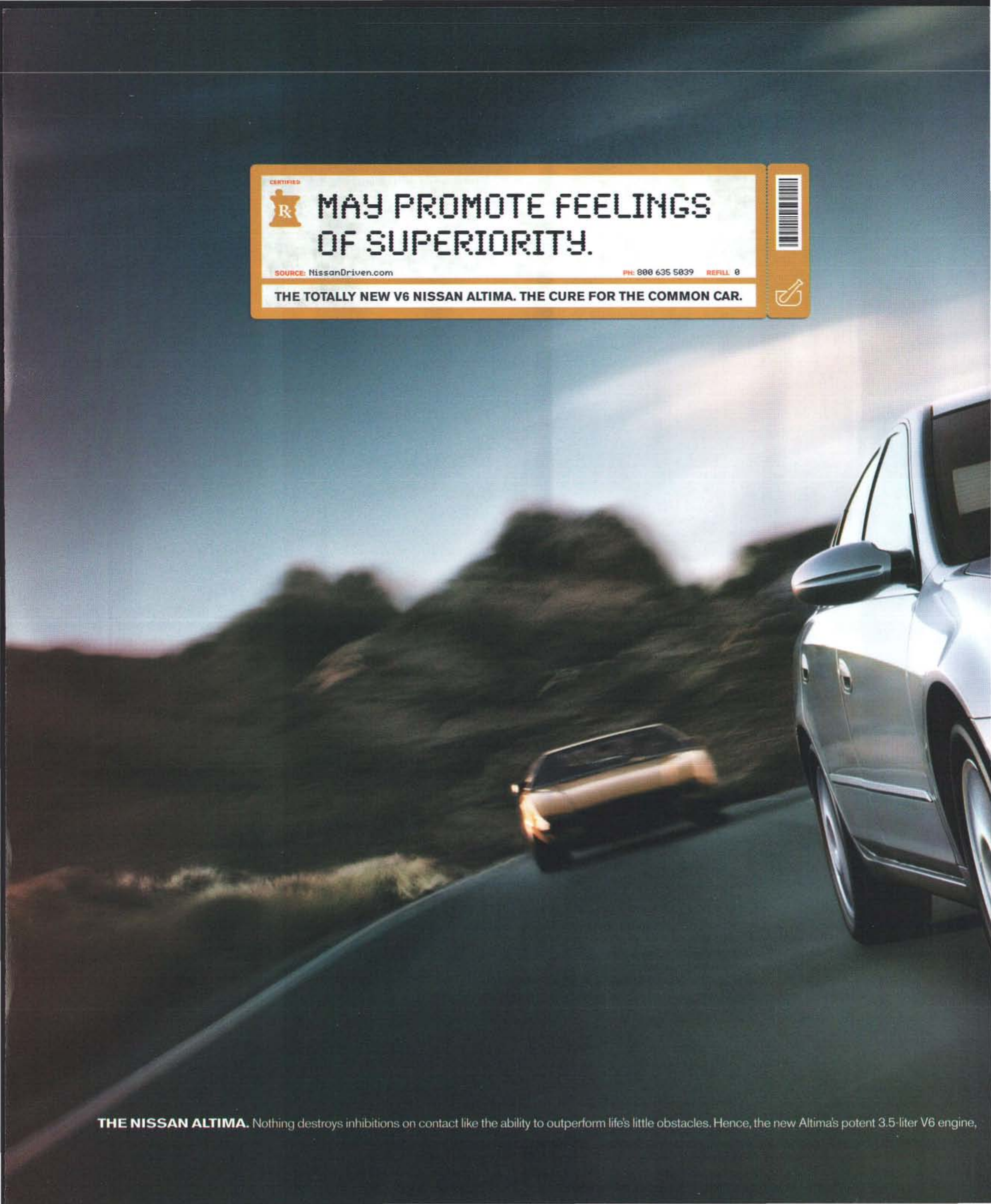
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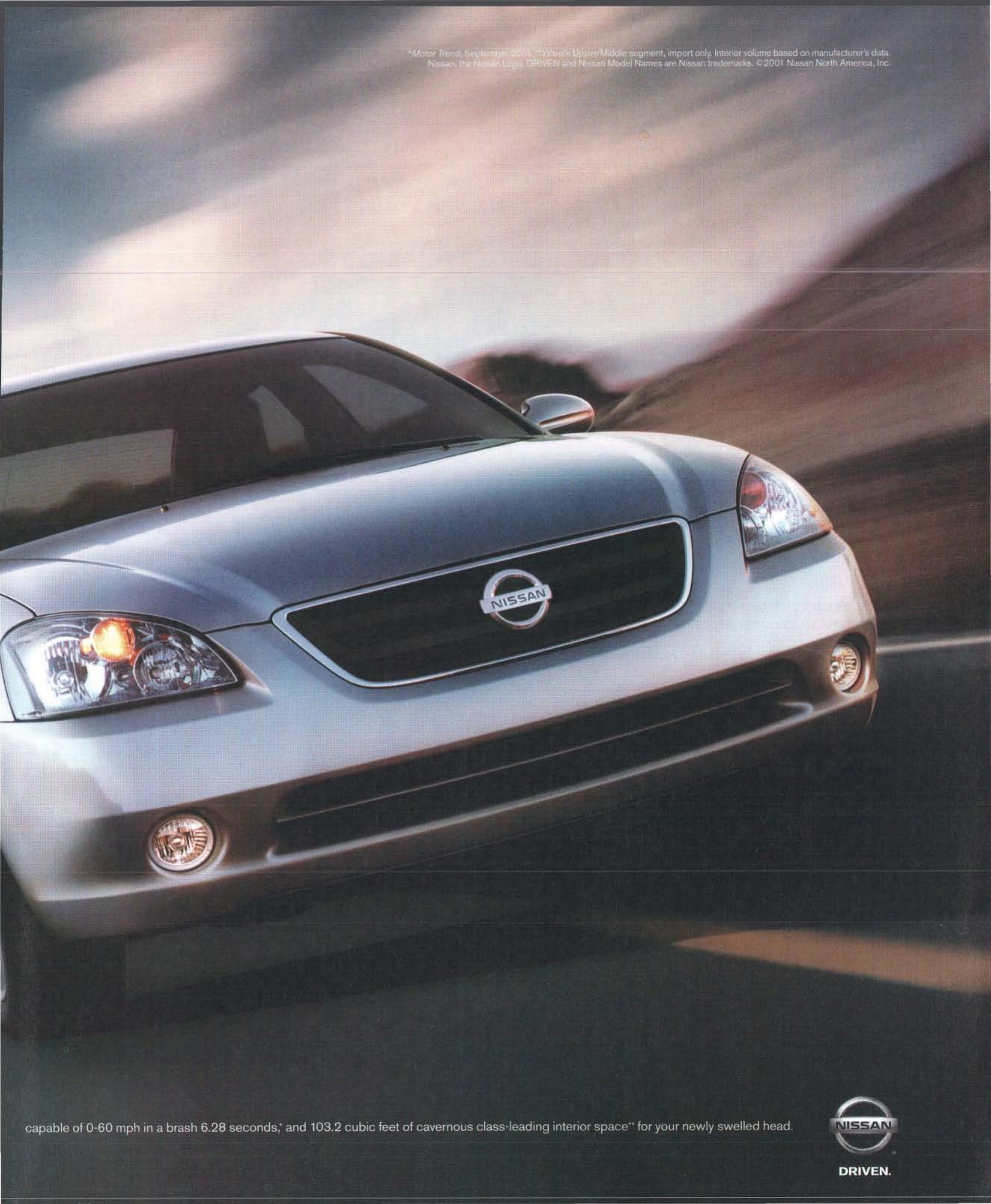

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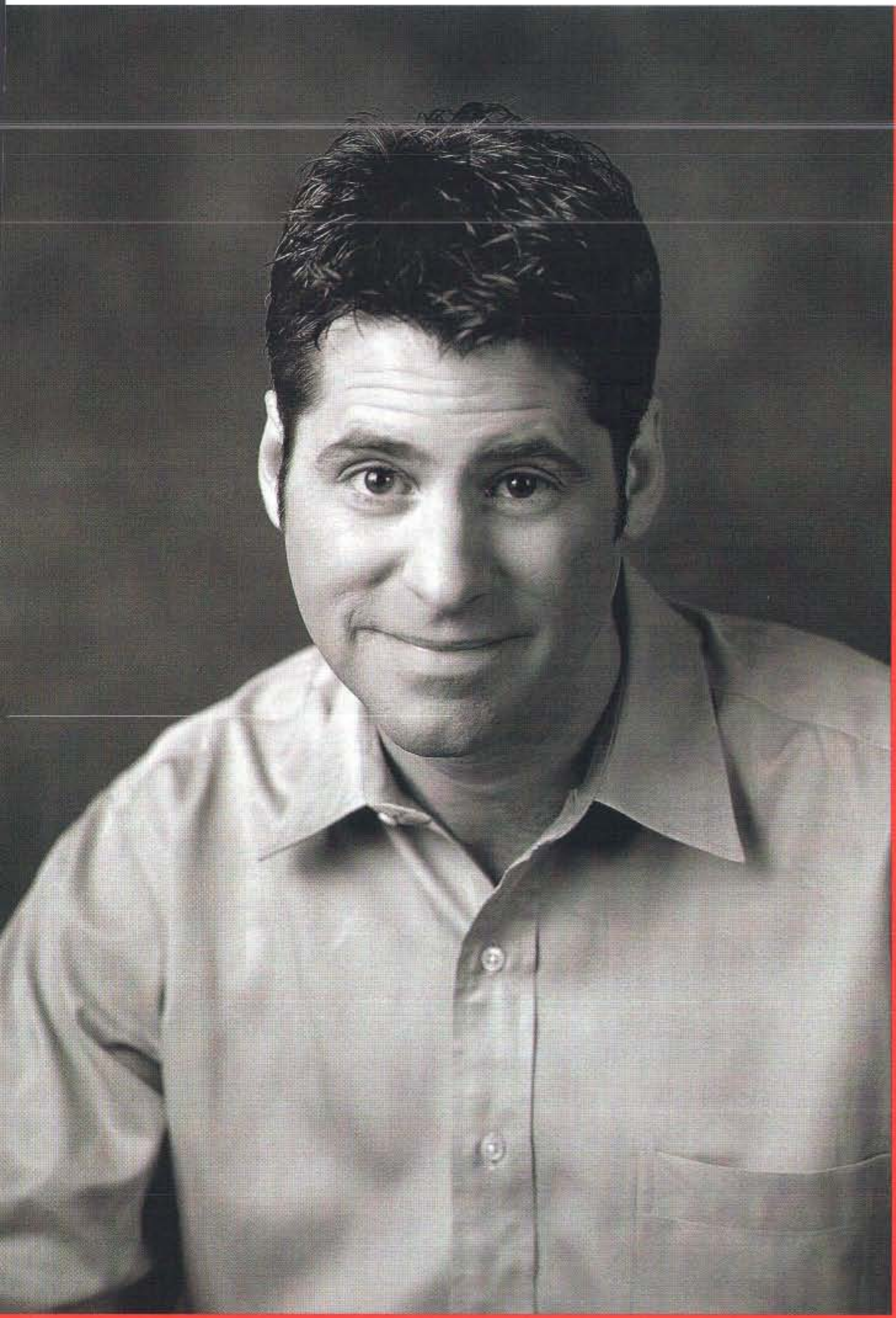

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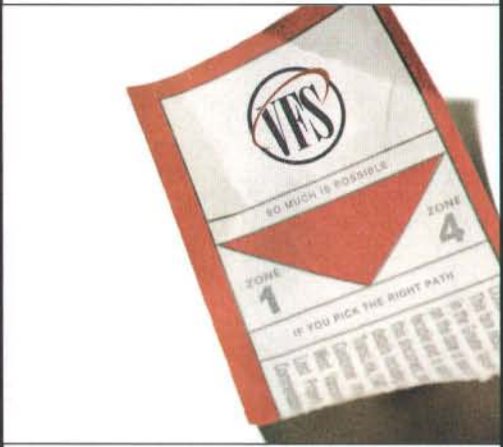

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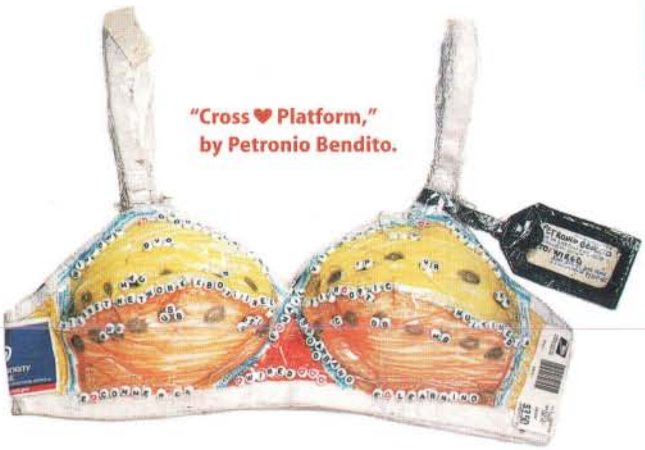


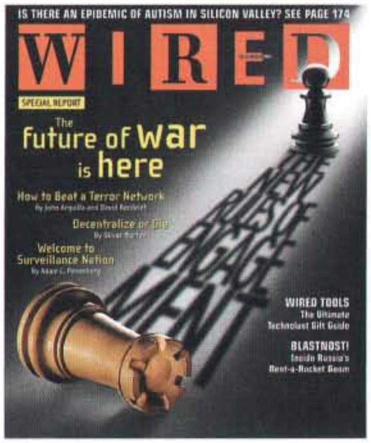
"Cross ♥ Platform," by Petronio Bendito.

Network Effects

In "Fighting the Network War" (*Wired* 9.12, page 148), you propose that governments should include non-governmental agencies in intelligence gathering. They should not.

Consider the International Committee of the Red Cross, which I represent in Washington, DC. The ICRC works in 50-plus areas of conflict or tension throughout the world. Merely the perception that we could be part of an intelligence-gathering outfit leads to regular intimidation, threats, and worse. It might well be a factor in several unexplained killings of Red Cross workers in Africa and elsewhere. That perception also amplifies the problem of getting access to civilians in war zones. ICRC is regularly denied access by suspicious warring parties. With the number of civilian war victims on the rise worldwide, we cannot afford anything that makes already precarious security conditions worse – or deadly. The lives of Red Cross workers and those who need our assistance depend on a clear understanding that our role is to help, not to snoop.

Urs Boegli
International Committee of the Red Cross, Washington, DC


IS THERE AN EPIDEMIC OF AUTISM IN SILICON VALLEY? SEE PAGE 174
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As a long-term advocate of decentralization for sociological and scientific purposes, I applaud "Divided We Stand" (*Wired* 9.12, page 152), which could have been titled "Divided We Foil." Market forces augmented by government fees and regulations have decimated a stronghold of decentralization – the rural economy. In the past 30 years, Wisconsin alone has lost more than 70 percent of its cheese factories (a de Gaullean-inspired plot?), and self-contained farms are dwindling at an alarming rate. My rural analytical microbiology laboratory has barely survived the increase in government license fees from $25 to over $10,000 a year, but centralized bureaucracy prospers. Thank you for your article, Oliver Morton.

Mary Leuther Glass
leutherlab@aol.com

Adam L. Penenberg's glib attempt to put a friendly face on the surveillance state ("The Surveillance Society," *Wired* 9.12, page 156) misses one vital point: access. True, citizen access to camcorders can "hold the state accountable," though those who most need this protection are usually those least able to afford it. Nevertheless, Penenberg breathlessly describes how forthcoming advancements in wireless technology and institutional data mining will reshape surveillance forever, pausing now and again to remind us that this is a side effect, not a goal. Interestingly, his examples suggest this side effect couldn't possibly be an accident.

To assume that access to camcorder technology will act as a deterrent to abuse is absurd. If I, as a private citizen, call a cell phone company or a transit authority to run a scan on someone who just robbed me, I'll meet a range of responses from a polite suggestion that I call the police to outright hostility. But if someone with a grudge accuses me of being a terrorist, law enforcement suddenly has access to all this and more, in some cases even without a court order – and it becomes my problem to prove I'm innocent. Don't worry, though, I've got my trusty camcorder; oops, they confiscated it when I was shoved into the squad car. Now what?

The assertion that we should just grin and learn to live with it is ludicrous. Access to technology is not the issue; access to the fruits of that technology (i.e., the databases) is what will determine the haves and the have-nots. Currently, anyone without a civic or government job is in that second category – which sounds like a textbook definition of concentration of authority.

Rich Pizor
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The Autistic Spectrum

Being the father of a 30-year-old son with high-functioning autism, I greatly appreciate the in-depth work you have done ("The Geek Syndrome," *Wired* 9.12, page 174). My wife and I have recognized many signs of geekitude in our own personalities for years – your articles just confirmed our perception.

Perhaps the extraordinary potential for creativity in people with high-functioning autism or Asperger's syndrome lies in their limited "theory of mind": They are less bothered by social conventions, and as a result they are capable of trying things that others would think impossible.

Extraordinary talents are also expressed outside science – in music, drawing, and painting. Unfortunately, many of these parents don't have a "bright" child with high-functioning autism or Asperger's syndrome; their child with autism is severely handicapped. That's why there is a dire need for appropriate services, in particular early intervention.

My son's creativity expresses itself in the invention of an imaginary city he calls Urville – not only in drawings but in the history and sociological organization of life. You can have a glimpse at *perso.libertysurf.fr/URVILLE*.

Paul Trehin
Secretary General, World Autism Organization
trehinp@aol.com

Your article about autistic spectrum disorder was eagerly read by the public because there is so little available about this neurological/biological/medical disorder. This is a worldwide epidemic. ASD has been recognized in the US only since 1994, and only then in children.

My husband, a graduate of Brown University with a degree in psychology, was diagnosed with Asperger's syndrome in 1996, and Tourette's at age 69. Because there was no information for me and my family anywhere in the US, we searched elsewhere and found support from the United Kingdom.

Today we are an organization called Families of Adults Afflicted with Asperger's Syndrome (*www.faaas.org*). My son, our webmaster, and I began FAAAS because we knew there were other families searching for similar answers for their ASD adult relatives. We also have an international listserv with members from 19 countries.

This article was so important to so many people.

Karen E. Rodman
Director/Founder, Families of Adults Afflicted with Asperger's Syndrome
faaas@faaas.org

Busting the Copyright Buster

In "May the Source Be With You" (*Wired* 9.12, page 78), Lawrence Lessig flatly states that "No code lives for 10 years." Hello? I wrote the Diskeeper source code in 1986 and it is still a big seller today, 15 years later. And has Lessig never heard of Unix, still in broad use 30 years later? His complaints about the unavailability of source code for educational purposes are baseless. Fast research quickly turns up a technical journal or two with code samples illustrating detailed explanations of the techniques. And is he unaware of the how-to books lining the shelves of bookstores everywhere, each with a CD-ROM full of source code tucked inside?

Craig Jensen
craig@executive.com

The most interesting aspect of "May the Source Be With You" is that despite Lawrence Lessig's view that copyright protection is too broad, he still manages to put a copyright notice at the bottom of his article.

Bret Parker
New York, New York

The Innovator's New Dilemma

In "No Apologies" (*Wired* 9.12, page 52), Phil Zimmermann is questioned about whether he is sorry for inventing PGP in the event that it was used by the September 11 terrorists. I wonder why he was singled out.

You should also be asking the Wright brothers, and the inventors of any other piece of technology that the terrorists could have used in putting together their evil plans. Perhaps they used a telephone? OK, put Alexander Graham Bell in the can for this one.

Technologists should hardly feel blame when someone perverts their technology for wrongdoing. Don't blame those who try to do good for the actions of those who try to do evil!

Alan Purchase
alanpurchase@hotmail.com

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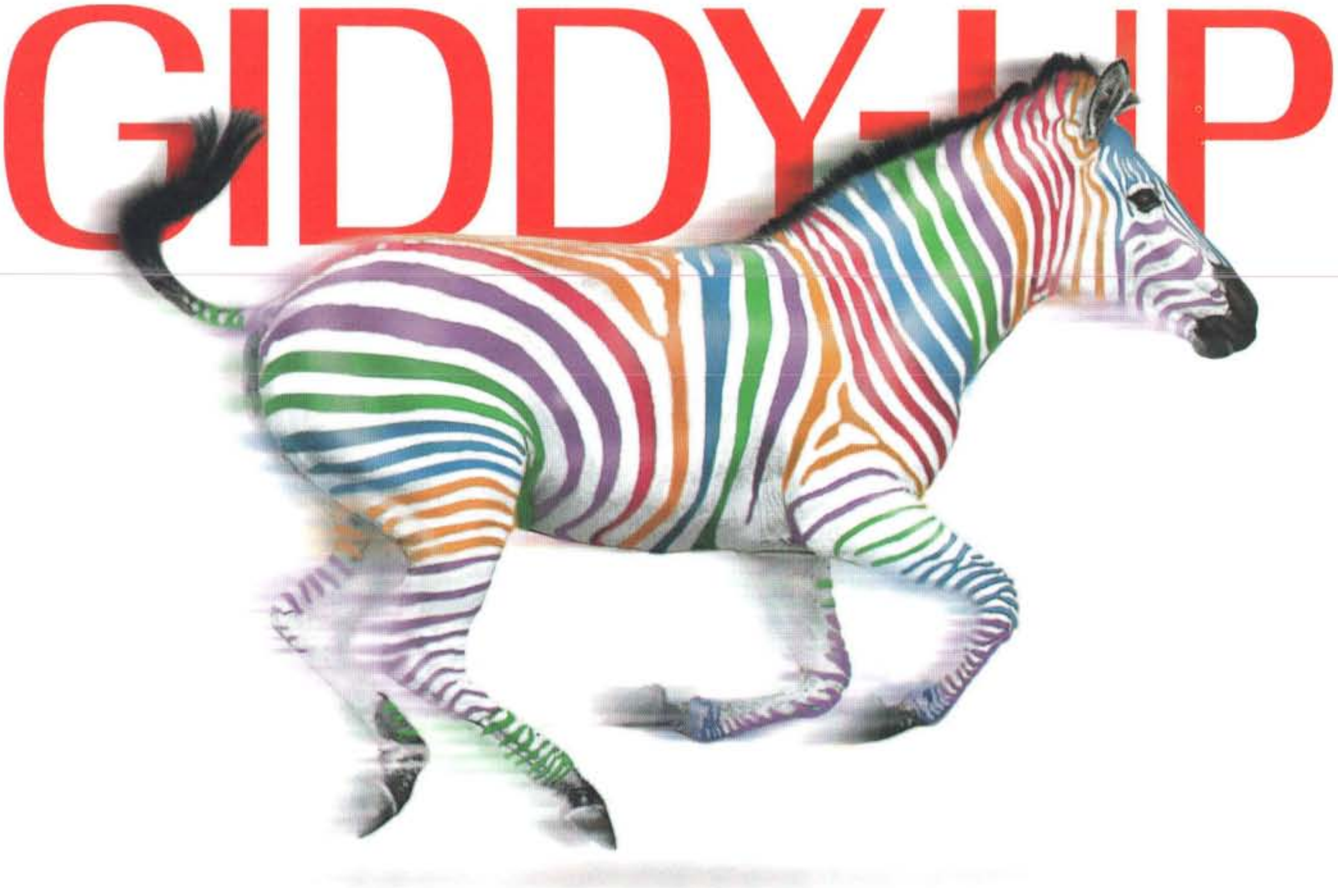

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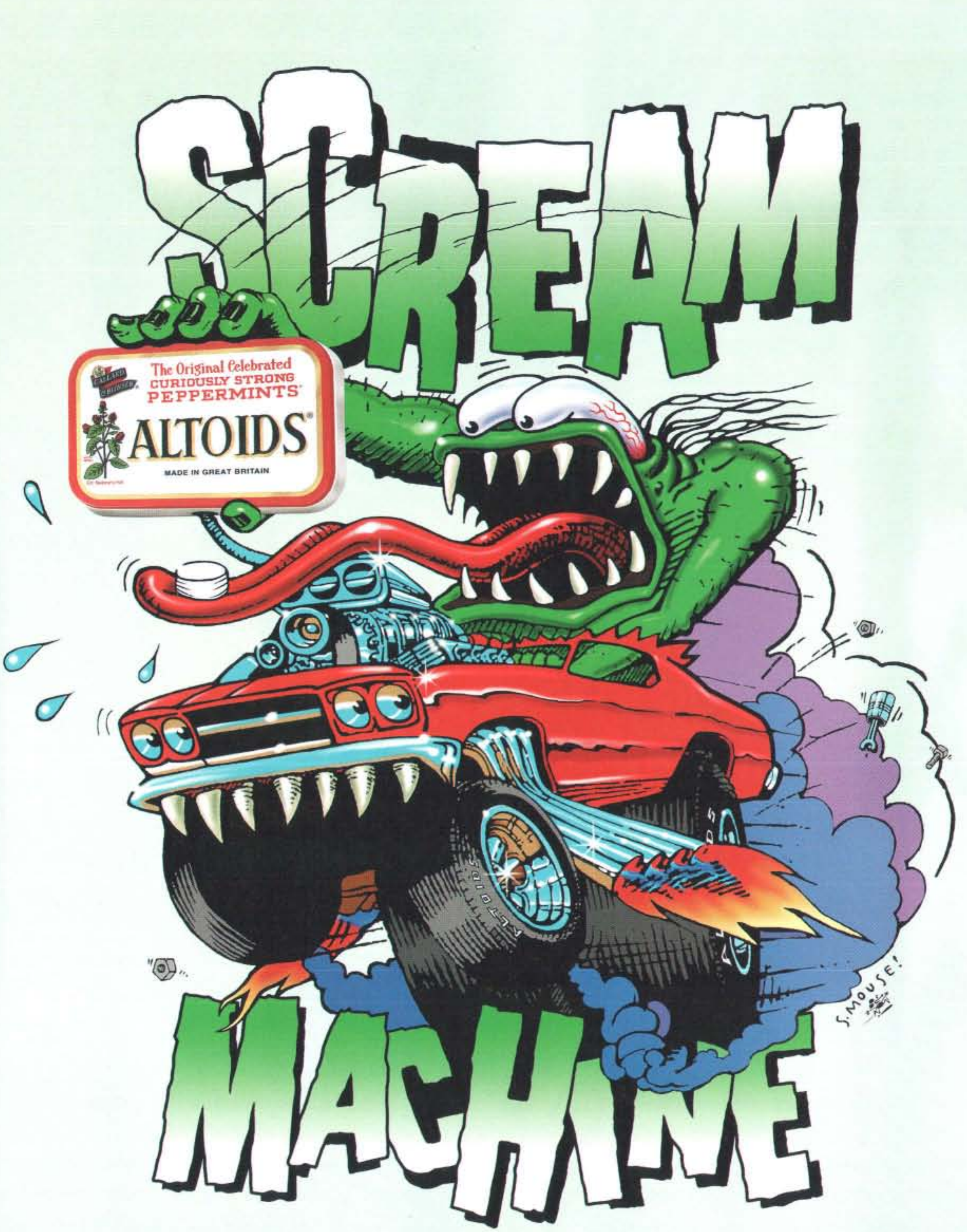

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RACER'S EDGE

Twenty-six hundredths of a second. That's what separated Dutch speed skater Jakko Jan Leeuwangh from a medal in the 1,000-meter race at the 1998 Winter Olympics in Nagano, Japan. And it's why the Dutch, US, and Australian teams stepped onto the ice in Salt Lake City this February wearing what may be the fastest suit in the West. The Nike-engineered uniform – an upgrade of the Swift Suit worn by gold-medal sprinter Cathy Freeman at the 2000 Summer Games in Sydney – is the product of nearly six years of research. Nike tested some 60 materials (like nylon and spandex) in various wind tunnels, recording the aerodynamic qualities of each. The trials showed that there is no single fastest material – the mesh used in a sleeve covering the narrow, swinging arm of a skater, for instance, won't offer the same performance advantages when it covers the wider, slower torso. The final Nike suit incorporates seven different fabrics – which ones, however, is top secret. – *Jessie Scanlon*

PHOTOGRAPH: CARLOS SERRAO

DIALUP BLIMP

Stealing a page from Rudyard Kipling – whose 1905 tale *With the Night Mail* envisioned a utopia in which transatlantic blimps revolutionized the postal service – Advanced Technologies Group is taking on the telecom industry. The London firm's StratSat airship (*www.airship.com*) offers a safe, low-cost alternative to conventional satellites and ground-based transponders. Filled with helium and fueled by gas and solar power, the ATG dirigibles hover 12 miles above Earth, safely over manned air traffic, and can maintain their positions within a half-mile radius for three to five years. Each can carry more than a ton of transmitting equipment and cover an area of about 72 miles – enough to serve a big city or even a small country. And ATG's got takers: Photran, a company backed by the Malaysian government, is signed up for a test-drive. – *Chris Baker*

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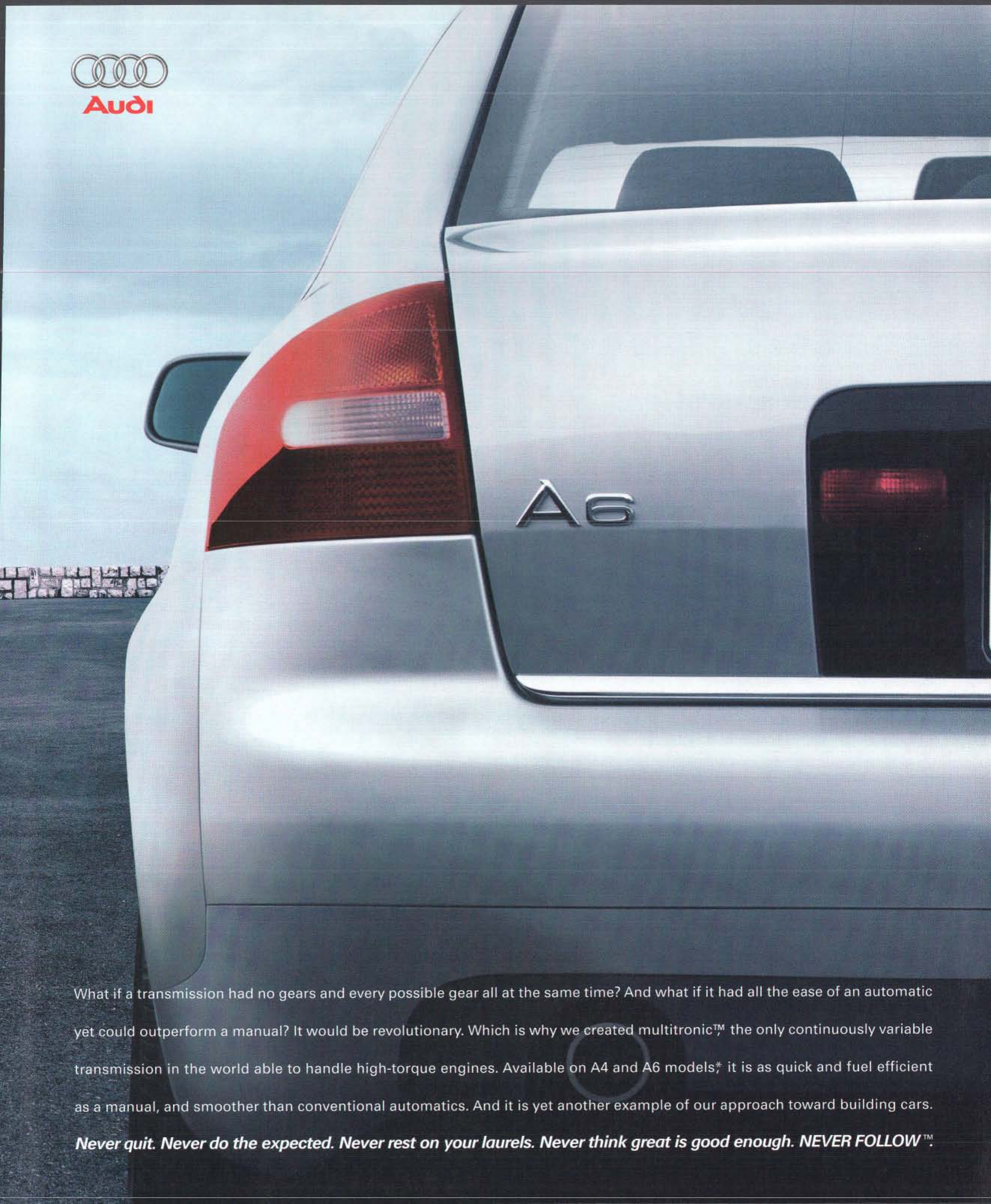

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SNOW JOB

"Snow is hard," says digital animation whiz Carl Ludwig. "There's light bouncing all over the place." Ludwig is the VP of R&D for Blue Sky Studios, which won an Oscar four years ago for its short film *Bunny*. Blue Sky's first feature, *Ice Age* (*www.iceagemovie.com*), opens nationwide on March 15, and like the earlier movie, it flaunts the company's ambient lighting techniques. While F/X geeks will appreciate that the animation is ray-traced – a time-consuming and expensive approach that Blue Sky makes less so through a combination of software shortcuts – everyone can enjoy the end result: subtle but realistic highlights, such as shadows in the ridges of this ice cave, not to mention in each footprint. Blue Sky's next step? Another feature, of course. – *Jennifer Hillner*

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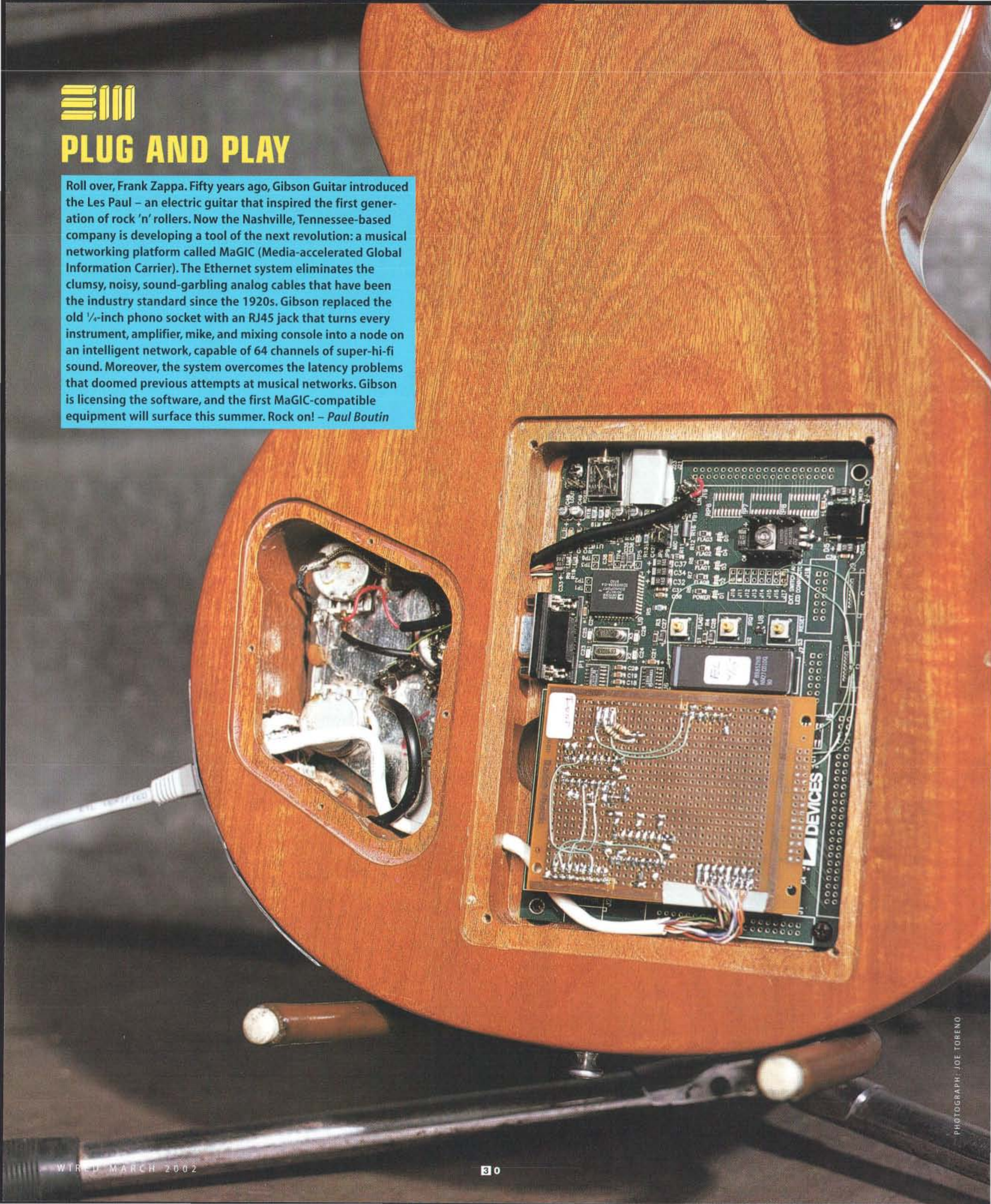
Thanks for the story, #8410. If anyone else out there has a Maker's story they'd like to share, please visit www.makersmark.com.

PLUG AND PLAY

Roll over, Frank Zappa. Fifty years ago, Gibson Guitar introduced the Les Paul – an electric guitar that inspired the first generation of rock 'n' rollers. Now the Nashville, Tennessee-based company is developing a tool of the next revolution: a musical networking platform called MaGIC (Media-accelerated Global Information Carrier). The Ethernet system eliminates the clumsy, noisy, sound-garbling analog cables that have been the industry standard since the 1920s. Gibson replaced the old ¼-inch phono socket with an RJ45 jack that turns every instrument, amplifier, mike, and mixing console into a node on an intelligent network, capable of 64 channels of super-hi-fi sound. Moreover, the system overcomes the latency problems that doomed previous attempts at musical networks. Gibson is licensing the software, and the first MaGIC-compatible equipment will surface this summer. Rock on! – *Paul Boutin*



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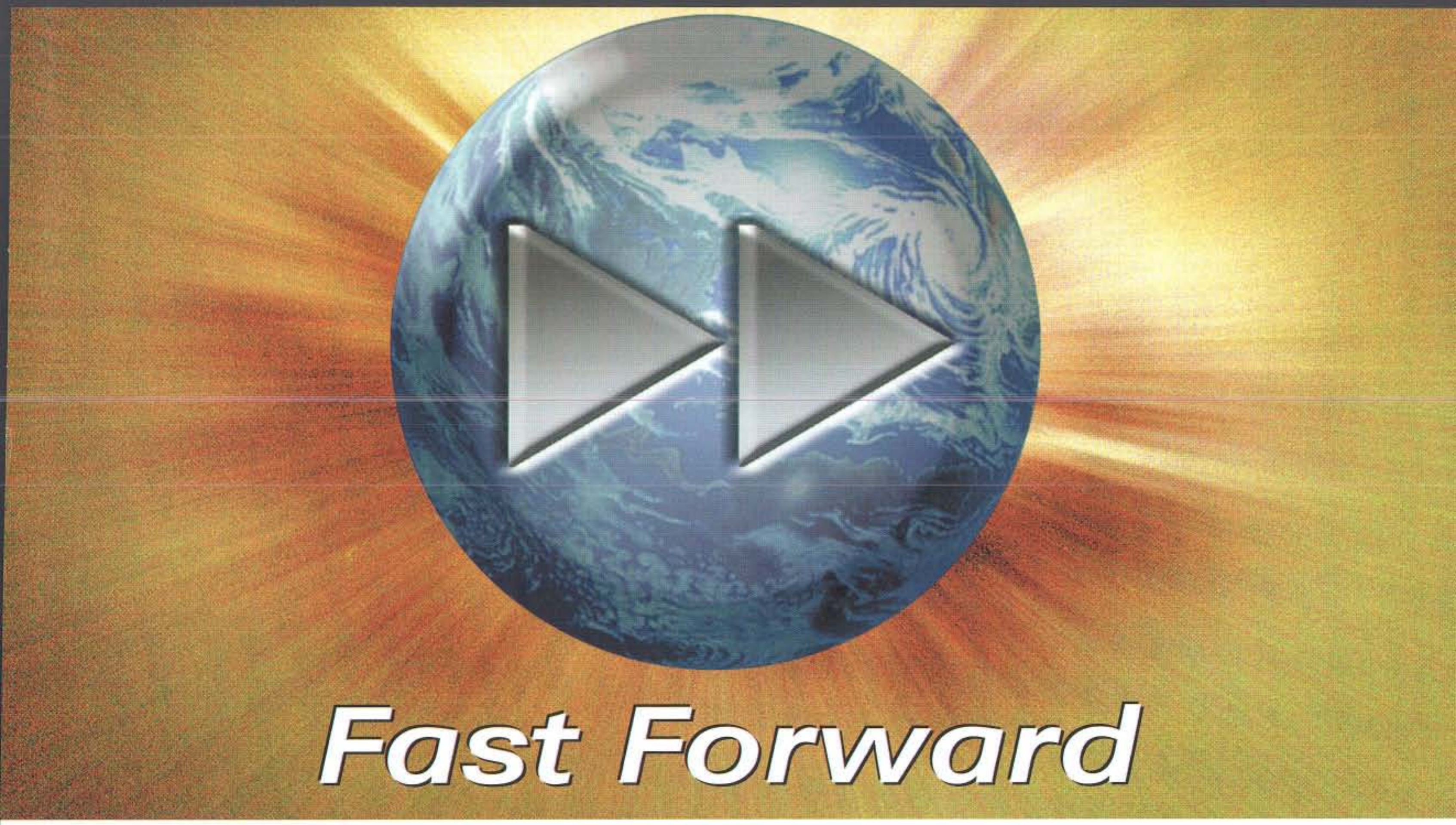

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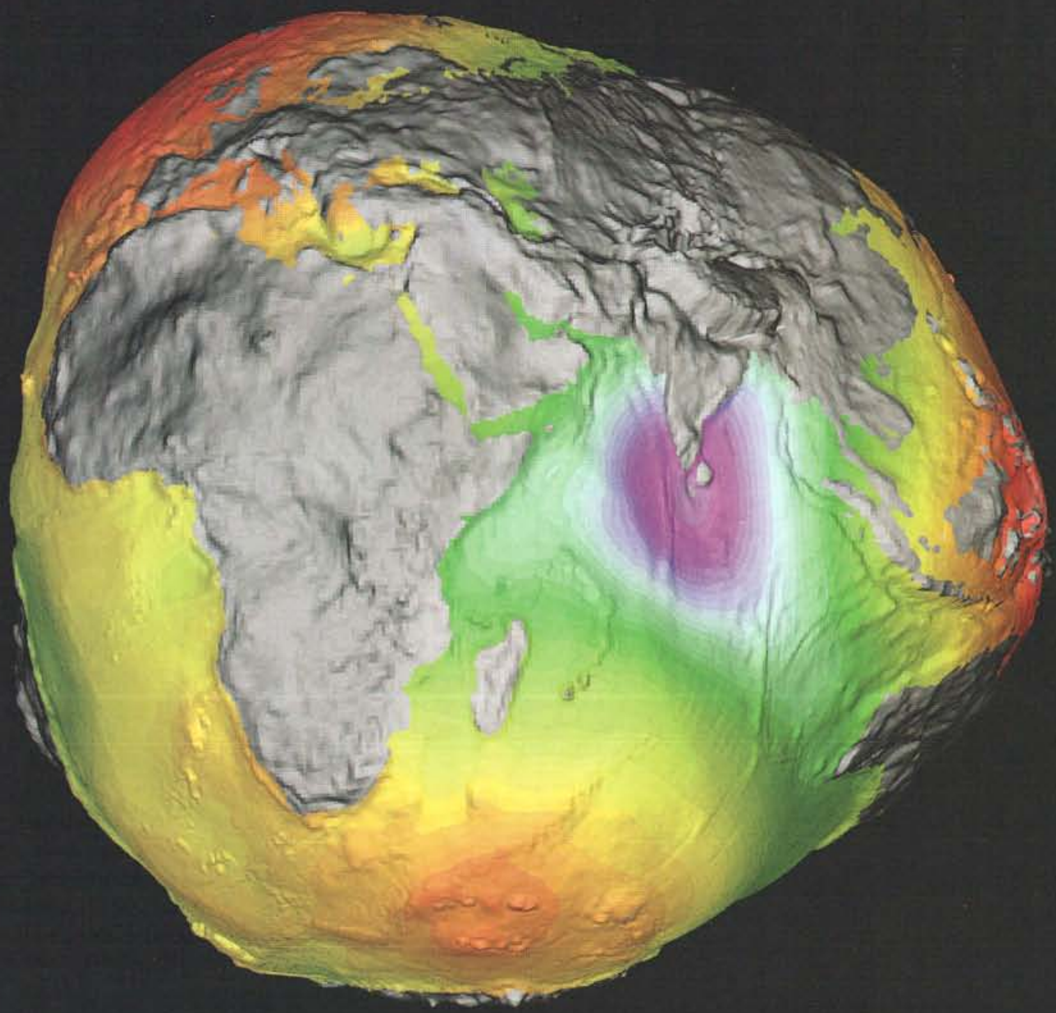

FIELD RESEARCH

Advances in small-satellite and GPS technology are helping NASA pull off a once impossible mission: the most accurate gravity map ever. Launching in March, the five-year, $90 million project (*earth.nasa.gov/missions/ref_web/mgrace.htm*) will chart the subtle changes in Earth's gravitational field over space and time, refining the vague data that's already been mapped (shown). A pair of satellites will circle the planet, traveling in the same orbit but one approximately 135 miles ahead of the other. Variations in gravity will deflect the orbit of the lead satellite, causing it to speed up or slow down relative to its twin. Using microwave radar, the satellites will measure the ever-changing distance between each other, right down to the micron. It's a thousand times better than previous methods, which depended on data compiled from more than 30 individually operated satellites using different measurement technologies. While NASA's findings will be a boon to oceanographers and geologists, the mission itself marks a coup for space navigation engineers who first proposed it 30 years ago. – *Michael Menduno*

IMAGE: DLR, GERMANY

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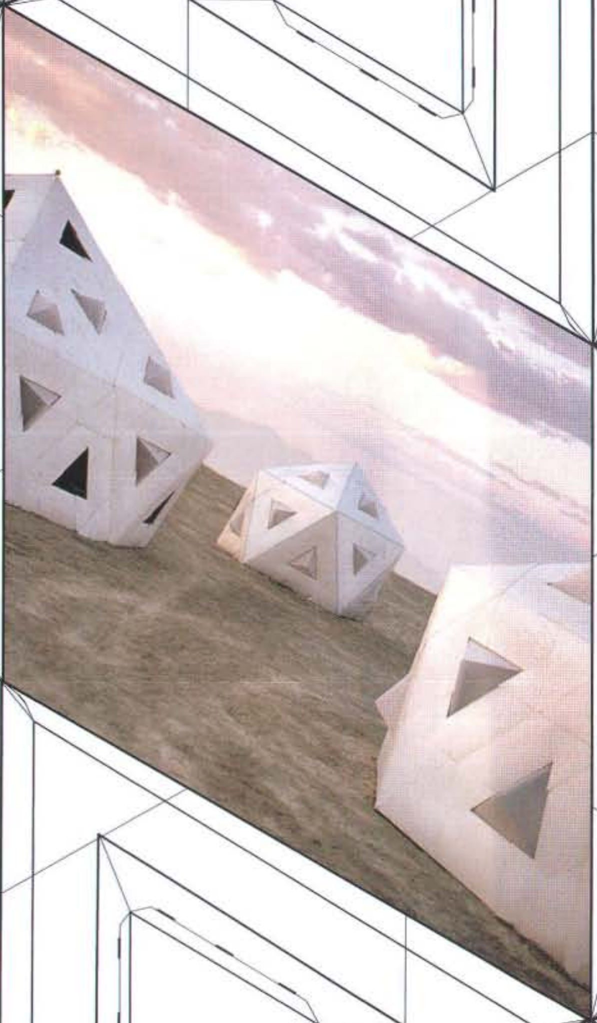
MOBILE HOME

Call it origami architecture. Entrepreneur-cum-designer Sanford Ponder has engineered a line of refugee shelters made of foldable materials. His Icosa structures (*www.icosavillage.net*) may consist of cardboard, corrugated plastic, or anything else you can die-cut, score, and fold. This flexibility is a critical factor for relief organizations, which are often required to support the local economy by using local materials and suppliers. "They can't just order a tent from New Jersey and ship it," says Ponder, whose design can be manufactured in almost any city. Cheaper, lighter, and easier to assemble than their competitors, the shelters – which range from 9 to 22 feet in diameter – are well insulated and waterproof and can withstand high winds. Now in the final design phase, the units should be in production by summer – less than one year after Ponder decided that if people must live in boxes, he was going to invent a better box. – *Alexander Rose*



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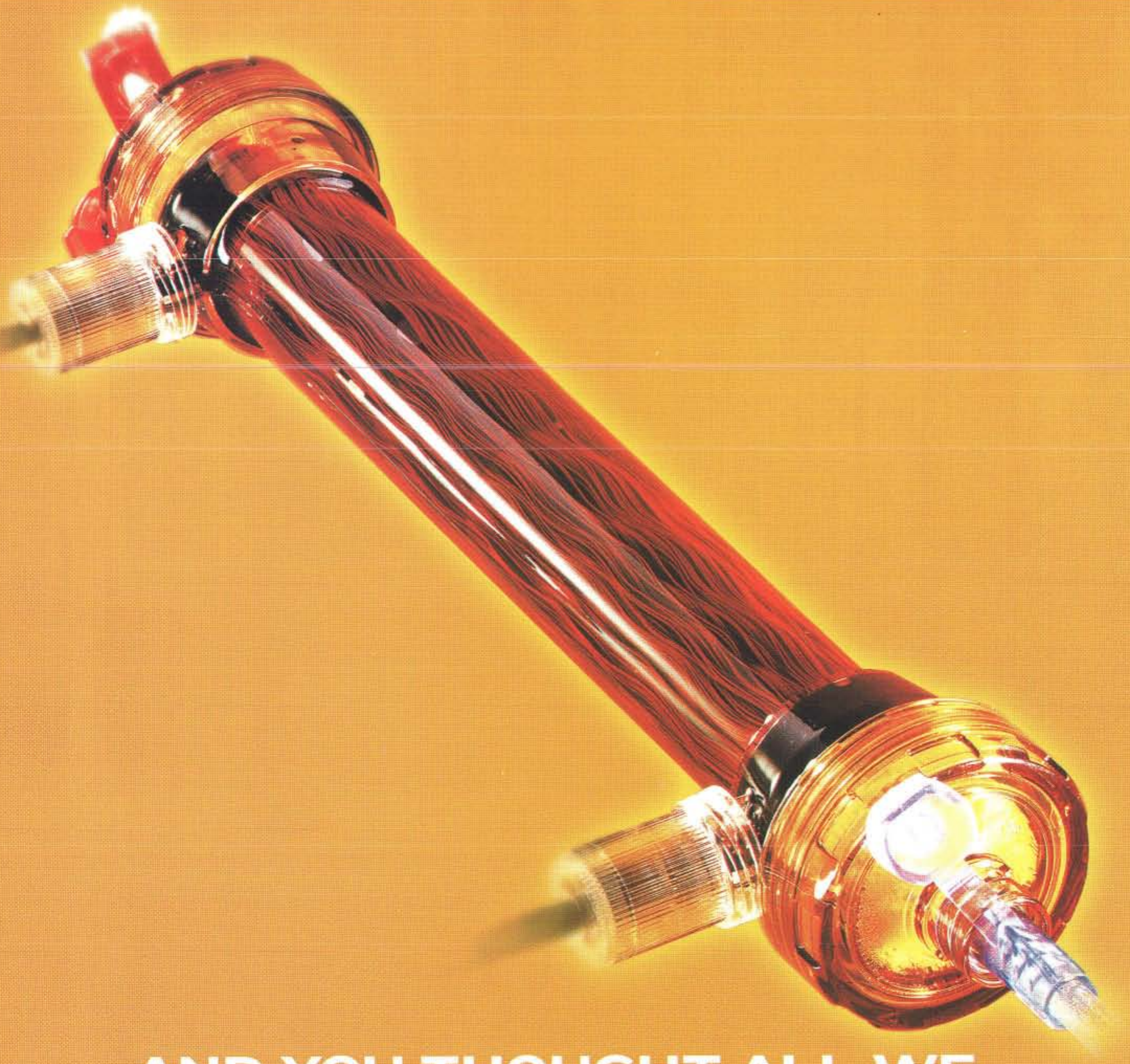

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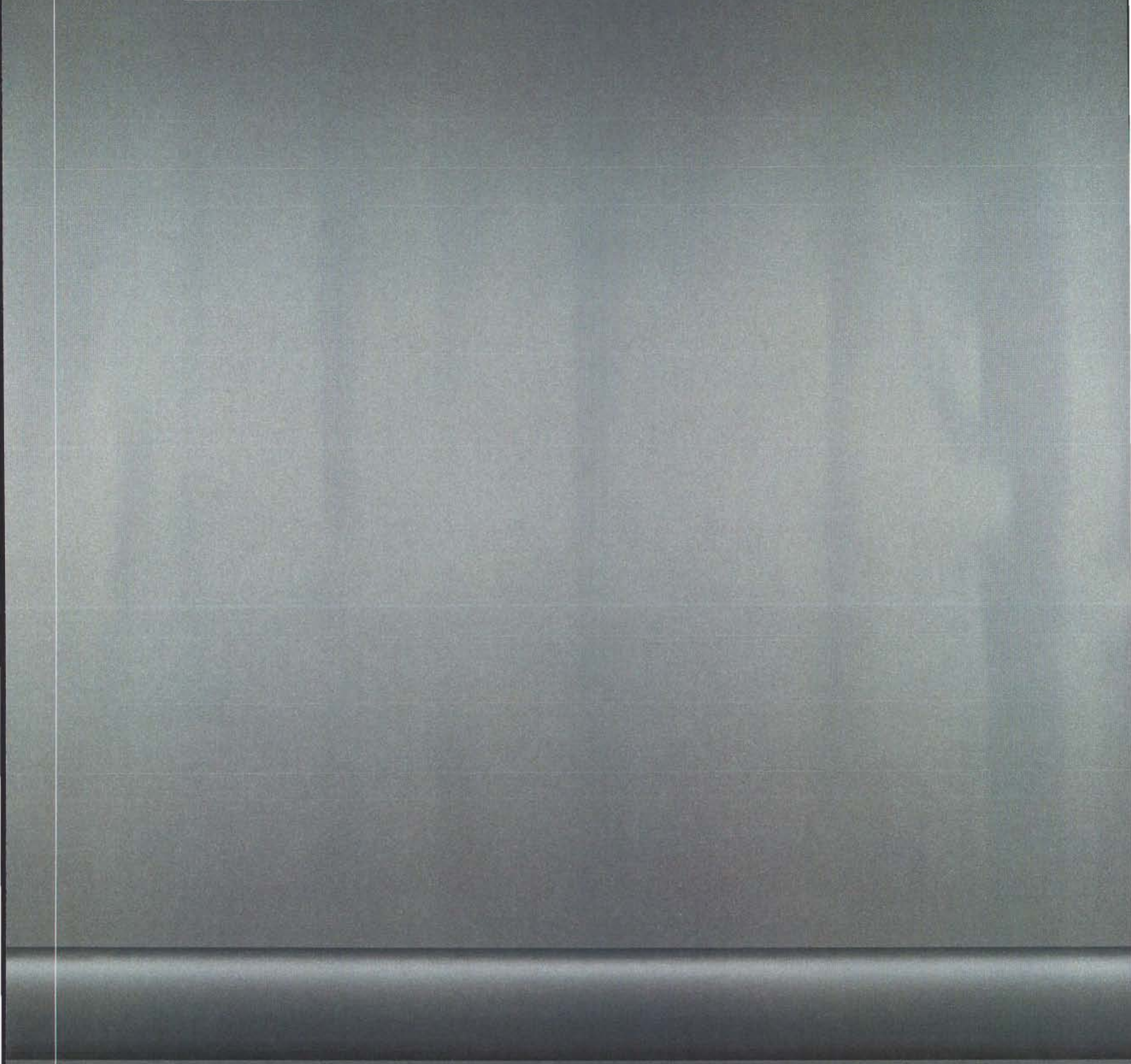

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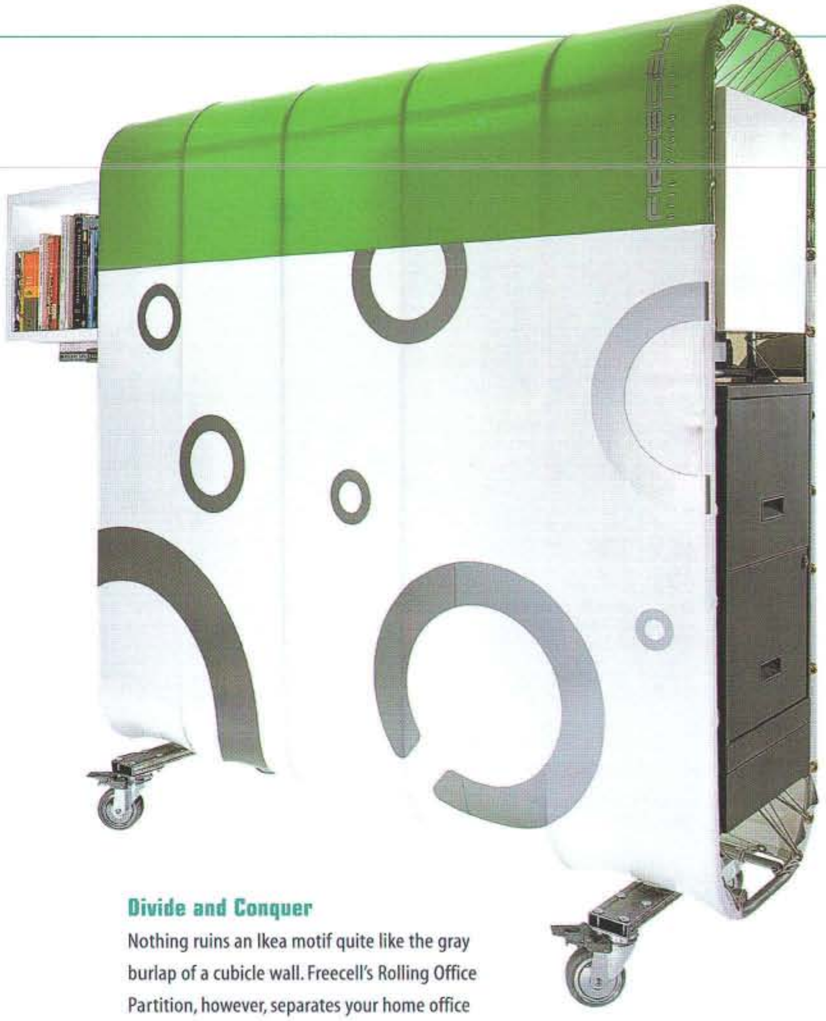
FETISH

By Sonia Zjawinski



Divide and Conquer

Nothing ruins an Ikea motif quite like the gray burlap of a cubicle wall. Freecell's Rolling Office Partition, however, separates your home office from your living room without disrupting the decor: The 5 x 5-foot divider comes in several configurations, and its skeleton – made of the steel tubing used to conceal electrical wiring – is covered with a tightly stretched vinyl skin. Wood bookshelves and two metal file cabinets store your supplies, while fluorescent lighting illuminates the unit from within, so your family will know when you're open for business and closed to goofing around.

Rolling Office Partition: $2,000-4,000. Freecell: +1 (718) 643 4180, *www.frcll.com.*

Beyond iPod

No, it doesn't look as cool as Apple's portable MP3 player, but Archos' Jukebox Multimedia costs $75 less and does way more. The player holds 10 gigs of data (up to 2,500 MP3s or 5,000 3-megapixel photos), records CDs directly from your computer or stereo, and comes with add-ons for reading CompactFlash and SmartMedia cards. What's more, by the time you hit the beach this summer, an optional 4X digital zoom camera ($35) and a camcorder ($50-80) will be available. Then you'll be able to keep 30 to 40 hours of MPEG-4 video, too.

Jukebox Multimedia: $325. Archos: +1 (949) 453 1121, *www.archos.com.*

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Don't risk warping your CD collection while your car bakes in the sun. With Sony's MEX-1HD, you can blast your favorite tunes on the road and keep your discs safe at home. The system, which installs like most other car stereos, rips up to 165 hours of music from CDs or Memory Stick onto its 10-gig hard drive. Upload more than an hour of tunes in 15 minutes – while you're listening to the album, clocking the news on NPR, or enjoying beats you've already stored.

MEX-1HD: $1,499. Sony: (800) 222 7669, *www.sony.com.*

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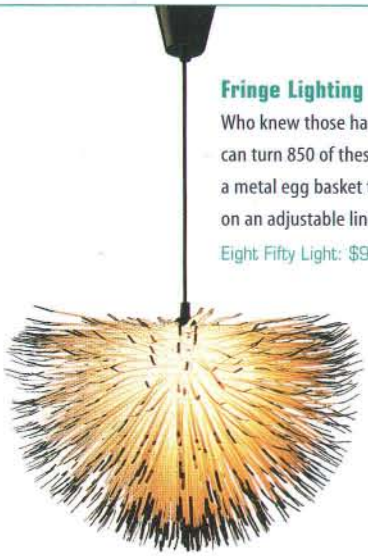
FETISH

Fringe Lighting

Who knew those hard-to-cut plastic ties could brighten up a room? Habitat, a British home-furnishing company, can turn 850 of these throwaways into a distinctive chandelier. The ties are hand-dipped in ink and attached to a metal egg basket that surrounds a 100-watt bulb. The resulting 19-inch tentacled globe hangs from your ceiling on an adjustable line, impressing guests with your recycled-chic fixture.

Eight Fifty Light: $95. Habitat: +44 (207) 255 6072, *www.habitat.net.*



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Minolta's DiMAGE X packs its optics and miniature parts vertically – not horizontally, like other cameras – so the zoom lens stays tucked inside. That tidy package (actual size shown here) translates into faster pictures: The 4.8-ounce shooter gives you 3X optical and 2X digital zoom in just over a second.

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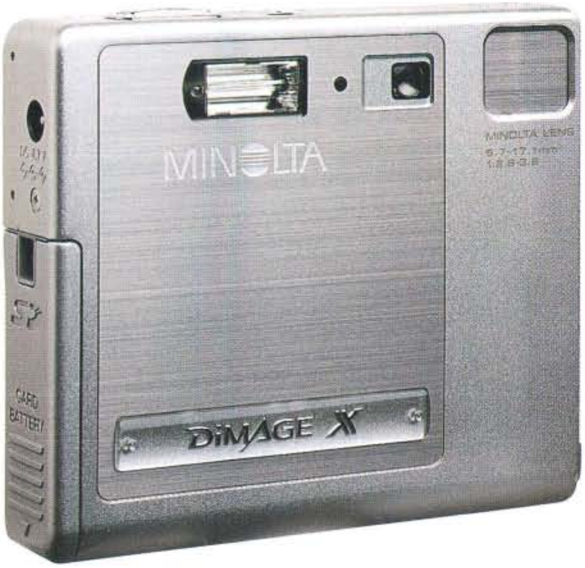

The Mighty Mini

The Mini's charmed '60s life was cut short when US emissions regulations halted imports. Now BMW is bringing it back – and raising the bar for roadsters. The sleek, affordable Cooper's 115 horsepower engine can hit 62 mph in 7.4 seconds. (Leadfoots take note: The 12-foot-long Mini maxes out at 125 mph.) Despite its demure stature, the four-seater won't crumple under pressure – its shell is reinforced in impact-prone spots, doubling crash protection compared with other subcompacts.

Mini Cooper: $18,000. Mini:
www.miniUSA.com.

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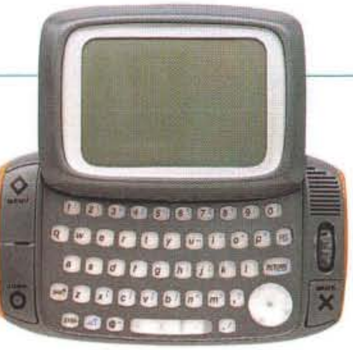
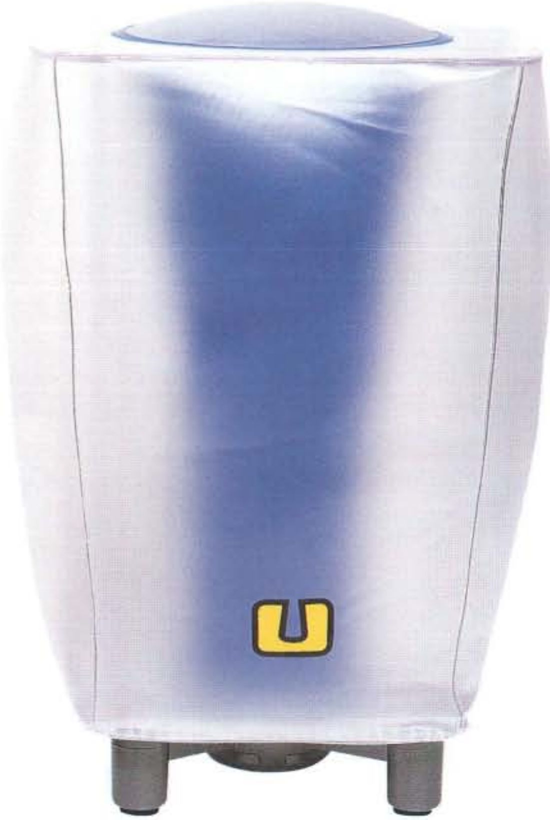


Fliptop

Unlike other wireless communication devices, Danger's hiptop doesn't simply repackage old tech and call it a new product. The 5-ounce cell phone/PDA runs the latest and greatest technologies on a Java-based OS, which gives it unmatched flexibility. It can handle all of the basic network protocols you'll need for global connectivity, as in GSM, GPRS, and 1xRTT (the superspeedy new CDMA network) plus run applications such as an HTML browser and attachment-friendly email. The headset port accepts a hands-free kit or an optional camera module (under $50) that lets you snap super low-res color images. Send notes with your pics by swiveling the LCD 180 degrees to reveal a BlackBerry-like keyboard underneath.

hiptop: $200. Danger: +1 (650) 289 5000, *www.danger.com.*



Rockin' on Air

Portable CD players let you move your tunes without breaking your back, but headphones let only one person at a time enjoy the music. Ellula has a solution: Blow up these 10-watt speakers like you would a beach ball and plug them into your player's headphone jack. Your harmonies will float across the surface of the thick plastic for all to hear. Thanks to NXT's flat-panel driver technology, the 10- by 5- by 5-inch speakers deflate to a mere 1 inch high.

HotAir Speakers: $45 per pair. Ellula: +1 (917) 519 2233, *www.ellula.com.*

PHOTOGRAPHS CLOCKWISE FROM TOP: COURTESY PERSONAL VALET; CRAIG MAXWELL, STYLING: JOHN MORTIMER/ARTIST UNTIED; CRAIG MAXWELL, STYLING: JOHN MORTIMER/ARTIST UNTIED

A New Legacy Is Born. In the hero community you have two types: Those that fight evil and those that happen to be around while others are doing the fighting. Introducing Jak (the fighter) and Daxter (umm, the other guy). Join them as they voyage to defy the forces of evil on an adventure many dream about…but few dare attempt. To find out more about their legendary quest, check out WWW.JAKANDDAXTER.COM

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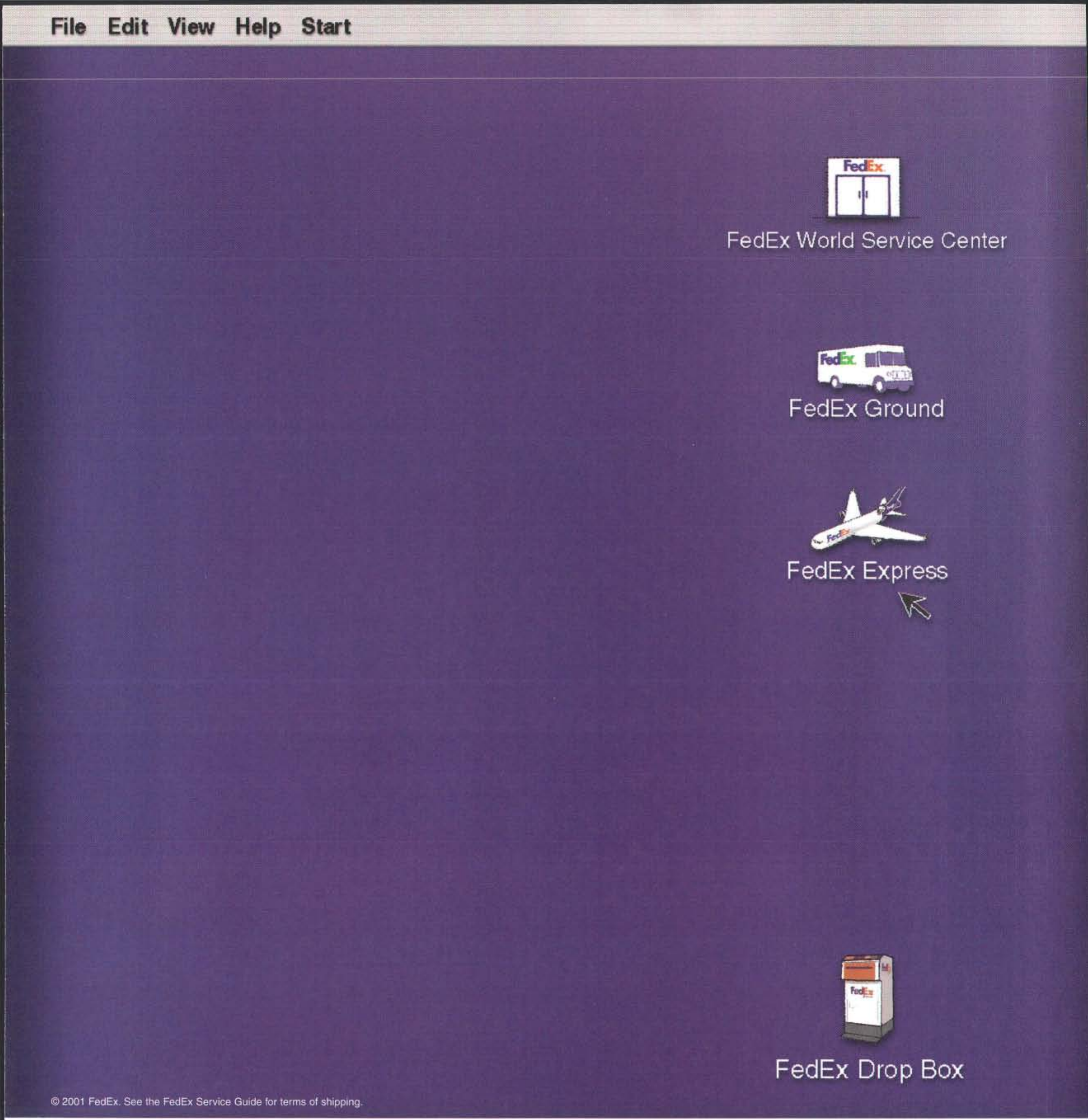

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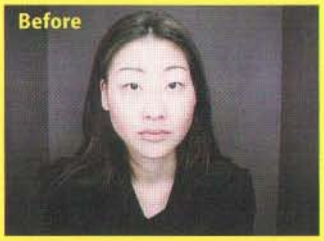
MUST READ

MARCH

Flash Face-Lift

PHOTOGRAPHY Step into a coin-op photo booth, and what the camera sees – like it or not – is pretty much what you get. Unless you're in South Korea, where the latest photo-strip machines offer mall rats beauty-enhancing options, from glamour lighting to virtual plastic surgery.

Teenage girls are the biggest market. One popular booth, Adlib of Wind, bathes them in ethereal light and caresses them with a hair-blowing breeze. But that's kid stuff compared with the digitized Beauty Plus booth. Customers can trim jawlines, puff up lips, eliminate blemishes, and give themselves Western-style eyelids (the most popular real plastic surgery procedure in Seoul). Choose a cartoon background, add stars or hearts, and – voilà – a whole sheet of photo stickers portraying the Stepford anime version of you.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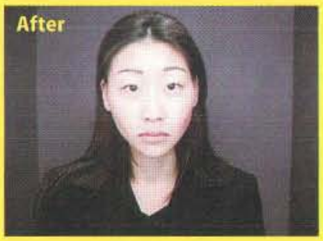
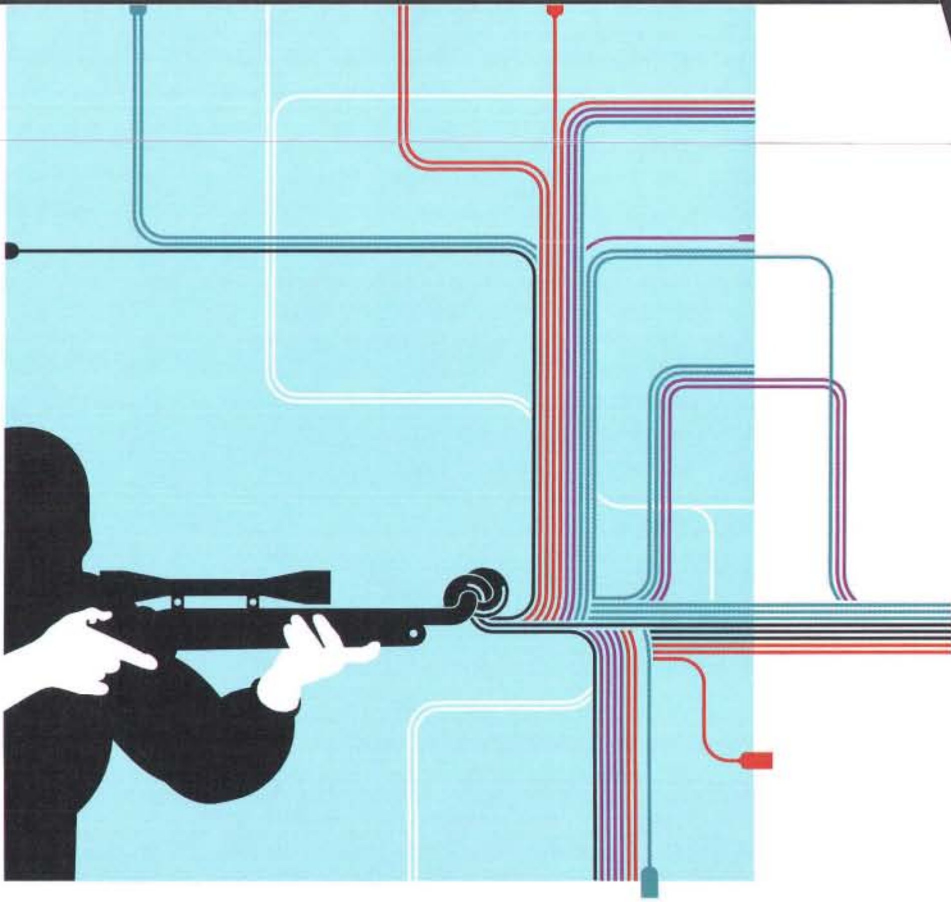

After

For many, this is practice for real surgery. In South Korea, 13 percent of the population has work done, compared with 3 percent of Americans. Korean teens go under the knife the way that Americans get their ears pierced: with a shrug. – *J. C. Herz*

ILLUSTRATION: RINZEN



The Broadband Terror Effect

By Robert Wright

If you wonder why radical Islam appeals to some Muslims, check out al Qaeda's recruiting video at CIAO (*www.ciaonet.org*) or other Web venues. There are images of Iraqi children starving under American-led sanctions, of Israeli soldiers manhandling Palestinian women, and of Osama bin Laden, looking messianic in his flowing robes, exhorting his brothers to rise up and end Islam's humiliation once and for all.

What's scary isn't the impact the Web-based version of this tape has had, but rather the impact it *hasn't* yet had. At the moment, most Muslim men susceptible to bin Laden's message don't have computers, much less modems. But the direction of technological evolution is clear: As the cost of processing and transmitting data drops, mobilizing interest groups – including radical ones – will get easier. This fact complicates the war on terrorism in ways few people in Washington have reckoned with.

IT REVOLUTIONS TRIGGER REVOLUTIONARY VIOLENCE.

For a spooky precedent, consider an earlier IT revolution that helped fuel a religious uprising, transform the geopolitical landscape, and turn a superpower into a former superpower: the coming of movable-type printing to Europe. In 1517, Martin Luther penned his grievances against the church in longhand, but within weeks

→

igh tech entrepreneurs in various German cities were selling typeset versions. To Luther's astonishment, his legions were self-organizing. What started as dissent became disaster - the "wars of religion" that wracked Europe during the 16th and 17th centuries. By the time the smoke cleared, the Hapsburg empire had lost ground and was destined to lose more. With Gutenberg's meme-replication technology empowering oppressed groups and helping to crystallize nationalist sentiment, the days of the European multinational empire were numbered.

What printing did to imperial governments, electronics could do to some national ones. The Ayatollah Khomeini revved up Iranian dissidents by audiocassette. But video is more compelling than audio, the Internet more efficient than the postal service. And desktop editing now lets amateurs manipulate emotions with a power once reserved for Hollywood potentates. A bin Laden recruiting video - which 10 years ago would have required $50,000 in editing equipment - can now be produced with hardware from Kmart.

All of this will reshape our view of the war on terrorism. Some emerging precepts:

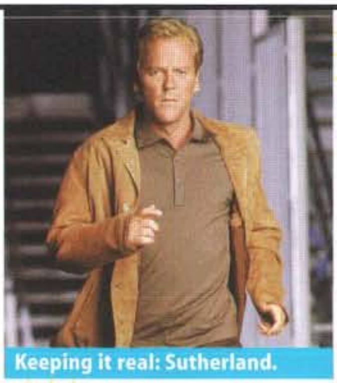
Define the enemy with care. President Bush has called this a war between civilized states everywhere and terrorists everywhere. But what's the difference between a terrorist and a freedom fighter? (Which are the Muslim separatists in western China? The Kurds in Turkey, Iraq, and Iran? The Hindu Tamils in Sri Lanka?) The cynical answer is that freedom fighters are the ones who finally win and get to write the history books. And the current IT revolution may mean that more separatist groups are destined for victory - just as the printing press swung the odds in favor of Italian, German, and Serb nationalists, all of whom finally carved nation-states out of an empire. Does America want a no-holds-barred war against oppressed people who will only get stronger with time - and who have some legitimate gripes to begin with?

WAR IS EASY. STOPPING DANGEROUS IDEAS IS HARD.

This isn't war. At least, it isn't your father's kind of war. As terrorists recruit, brainwash, and organize in cyberspace, they'll depend less on physical training camps of the sort that American bombs excised from the Afghan landscape. So the cost-benefit ratio for Afghan-type wars will grow. American bombs - the evidence of their destruction beamed around the world via Web site and satellite - will enrage at least as many future terrorists as ever, while disabling fewer terrorists than before.

Much of the Bush game plan could have been written 50 years ago: Find the enemy's home base, destroy it, and kill your foes. The long-run success of this strategy is unclear. (Does it foment a hatred of America that will fester in virtual space and come home to roost?) What does seem clear is that such strategies will be less effective five years from now, to say nothing of 50. Killing Osama bin Laden and his kind is one thing. Killing his memes is getting trickier all the time.

Robert Wright is the author of The Moral Animal *and* Nonzero: The Logic of Human Destiny.



Keeping it real: Sutherland.

Fox TV's *24*: Believe It or Not

MEDIA Fox's prime time drama *24* has a brave front of believability: The good guys are flawed, cell phones drop out of range, guns run out of ammo – and it all unfolds in real time. (Series summary: Kiefer Sutherland plays a federal agent trying to foil an assassination plot against a presidential candidate.) But does it hold up to a reality check? We grilled cocreator Robert Cochran and writer Michael Loceff on some of the show's flashier tech moments. Then we surveyed real experts and scored *24* on a scale of 1 to 10. – *Hugh Garvey*

INSTANT PASSWORD HACK

Kiefer Sutherland's character wants the password to his missing daughter's email account. "If I give you a phone number, can you give me all the Internet passwords connected to it?" he asks.

Behind the Scene: It's plausible, Loceff says, as long as you assume that "as a requirement for working in the Counter Terrorist Unit you had to have your lines monitored."

Expert Opinion: Good answer, says inspector Glenn Sylvester, a computer forensics expert for the San Francisco Police Department. "If you had a [packet] sniffer box installed at the ISP, you could get the passwords."

Creativity: 4
Plausibility: 8

SEVERED THUMB SECURITY SCAN

Kiefer Sutherland cuts the thumb off of a dead bad guy and tries to identify him by scanning the print of the dismembered digit using an optical scanner on his car's dashboard.

Behind the Scene: "Sure it's possible," Loceff says. "It's just a plain scanner getting a moisture print."

Expert Opinion: Some security-access scanners can detect and reject dead fingers by measuring blood flow, says Damon Wright of Identix, a company that makes biometrics systems. But "it's also absolutely possible to identify a dead individual or a dead finger," he says. (Arnold Schwarzenegger used the same trick in 2000's *The 6th Day.*)

Creativity: 3
Plausibility: 10

PLASTIC SURGERY IDENTITY SWITCH

To infiltrate a rally for the presidential candidate, an assassin gets plastic surgery to make him the spitting image of a photojournalist who has press access.

Behind the Scene: "If you get people with similar facial structures," Cochran says, the trick would work. To make it more believable, the producers "slapped a slightly bigger nose" on the actor (who plays both the journalist and the impostor) when in his assassin's role.

Expert Opinion: Unless the men's bone structures were very close, it's unlikely surgery alone could alter a face enough. Says plastic surgeon Katherine Young: "You would have better luck with hair and makeup."

Creativity: 7
Plausibility: 2

VIDEO STILLS: COURTESY TWENTIETH CENTURY FOX TV

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Beijing, We Have Liftoff

SPACE TRAVEL Call it China's Great Leap Upward. More than four decades after cosmonaut Yuri Gagarin orbited Earth, China aims to become the third country to send a human into space. In 2001, the world's most populous nation practiced by launching turtles and snails. Once a manned mission succeeds, likely within a year, the next step seems obvious: put a person on the moon.

The longstanding but chronically underfunded program is finally pressing ahead, fueled by revenue from trade zones like Shanghai and Hong Kong. China's motives are unclear – outside of bragging rights over galactic wannabes like India and North Korea. "This is the way big powers represent themselves," says Charles Vick, an analyst on China's space program with the Federation of American Scientists. "It's the alpha male beating his chest."

The Chinese are proud of their role in space history. Gunpowder, which dates back to the Song Dynasty, was the seed of modern rockets. The Long March booster rockets and the *Shenzhou* (or "Magic Vessel") capsules were developed in China, influenced by Russia's program. When they reach orbit, the astronauts – known as *yuhangyuan* – will be able to see for themselves one of the few man-made structures visible from space: the Great Wall. – *Ted Rose*

Propaganda mission: China boosts its space program at home.

BIG NUMBER

5

PERCENT

Portion of the Internet that is not universally accessible because of routing that's inaccurate, damaged, or outdated. This "dark Net," researchers say, includes as many as 100 million hosts.

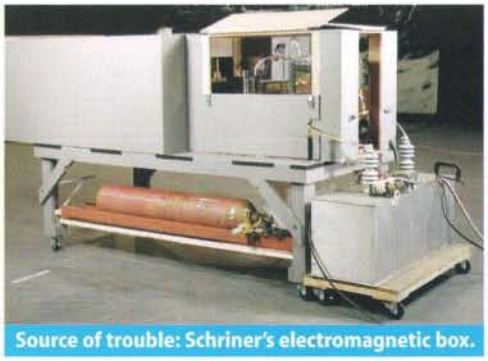
One Zap, and Your Computer Is Dead

EWEAPONS Inventor David Schriner calls it a "transient electromagnetic source." But you can just think of it as the perfect terrorist weapon for the wired age. Schriner's latest device can send an electromagnetic pulse through a wall to shut down computers up to 80 feet away. Imagine, he says, if a terrorist pulled up in front of the New York Stock Exchange with one of these babies on the passenger seat.

As the US becomes exponentially more dependent on electronics, it becomes increasingly vulnerable to just such attack – and a disabled Internet node or cell phone network could cost billions.

American officials have been worrying – and dreaming – about the potential of EMP weapons since they unleashed Test Shot Starfish in 1962. The 1.4-megaton hydrogen blast 250 miles above Johnston Atoll in the mid-Pacific unintentionally knocked out radio communications and satellite equipment for thousands of miles around.

Schriner, a retired Navy weapons engineer, told Congress in 1998 that terrorists wouldn't need weapons-grade explosives to unwire the US. All they'd need is a few hundred dollars' worth of hardware from Home Depot and Radio Shack, a bunch of car batteries, and some know-how.



Source of trouble: Schriner's electromagnetic box.

Congress was frightened enough to give Schriner $1 million to build such a device. The grant is heading for renewal this year. The devices on the drawing board are portable and small enough to fit in a van, yet powerful enough to take down airliners or pull every critical patient in a large hospital off life support.

British defense firm Matra BAe Dynamics last summer announced it had built a battlefield electronics killer around a small explosive. (Kind of like the ebomb in *Ocean's 11*.) The US Air Force has been testing similar weapons since at least 1993.

The revolution in small, cheap electronics has also spawned the means of its own demise. In theory, the defense is easy. "Sometimes the fix is a 10-cent device, like putting a ferrite doughnut around the mouse cord," Schriner says. "But until people know about the threat, they can't do anything about it." – *Dan Baum*

PHOTOGRAPH TOP: KEVIN LEE/GETTY IMAGES

The reader's guide to laughter.

THE
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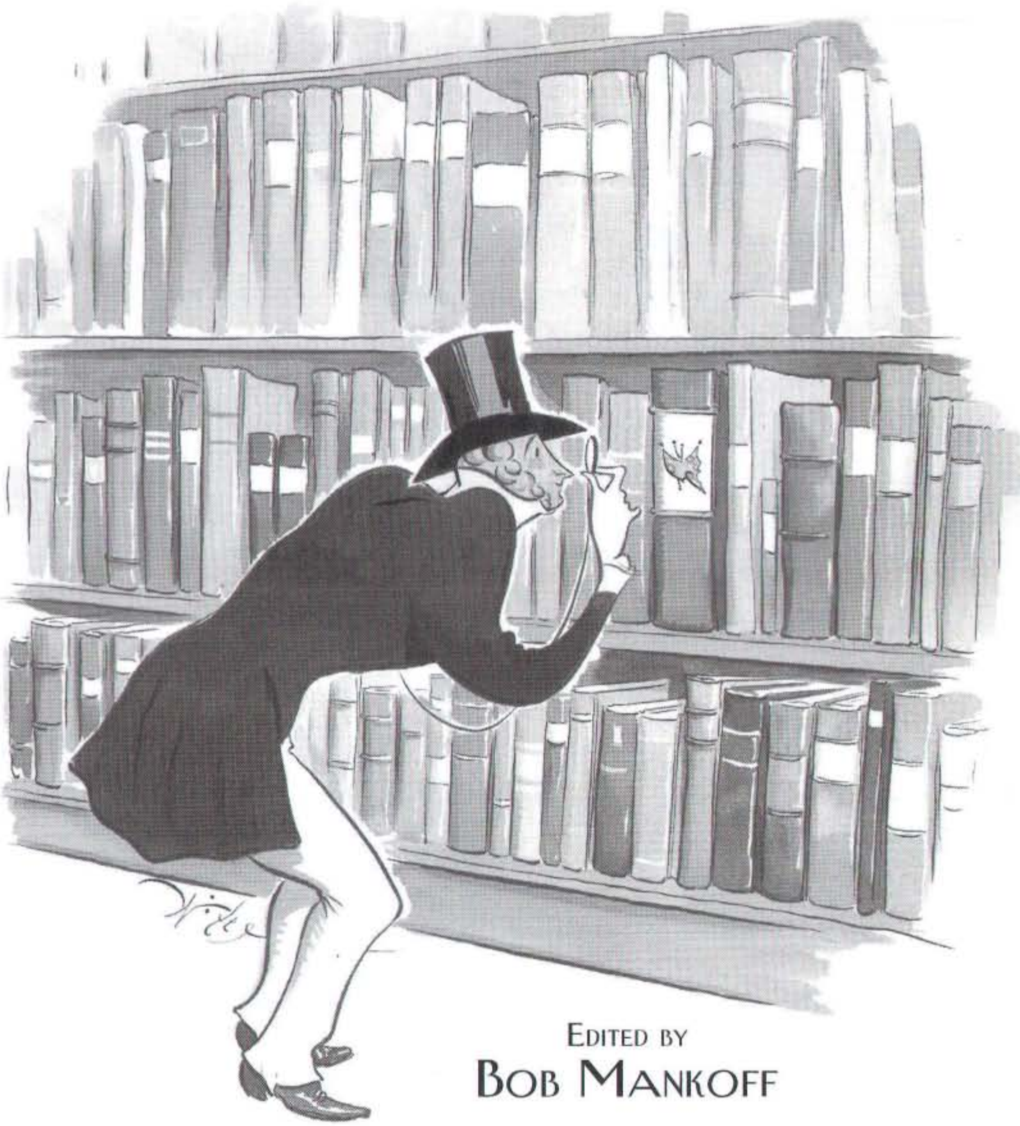
BOOK OF LITERARY CARTOONS



EDITED BY
BOB MANKOFF

From the stunning and the sublime to the purple and pretentious, here, in 104 drawings, are dead-on portraits and eye-opening ruminations on all things bookish, writerly, and readerly as illuminated by renowned *New Yorker* cartoonists, including Charles Barsotti, Roz Chast, Ed Koren and Victoria Roberts.

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A New Kind of Cool

Picture a foldaway ice rink, or a completely silent refrigerator, or an air conditioner so tiny it can cool microscopic hot spots on a computer chip. Far-fetched? Not anymore. After three decades of stagnation, the field of thermoelectrics is heating up.

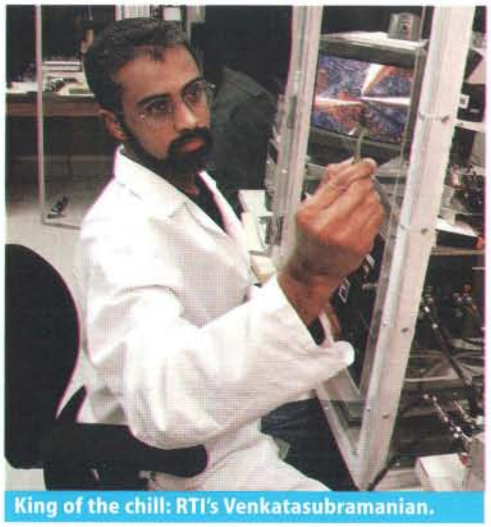
We'll spare you an exegesis on thermodynamics. Suffice it to say that in 1834, a clever Frenchman named Jean-Charles-Athanase Peltier noticed that running electricity through two dissimilar conductors sets up a heat pump without any moving parts. The current pushes heat toward one end of the circuit, cooling the other end. A related phenomenon can also be exploited to turn heat into electricity. These thermoelectric effects have been harnessed to cool the lasers in fiber-optic lines, create greener refrigerators (like Igloo's SpaceMate), and fuel mini power packs for deep-space probes like those used in the Cassini mission to Saturn.

SUPEREFFICIENT REFRIGERATION FOR THE KITCHEN, THE PC, AND THE LAB.

But the technology hasn't progressed much since the 1960s due to the thermoelectric limitations of most materials. Historically, the best conductors allowed for only 10 percent efficiency, meaning about 90 percent of the energy input is wasted. A good compressor-driven fridge runs at about 40 percent efficiency.

That's where scientists at North Carolina's Research Triangle Institute made their breakthrough. Funded by the Defense Advanced Research Projects Agency, RTI engineers concocted a heat pump using two atomically precise superlattices of bismuth telluride, one layered with antimony telluride, and one with bismuth telluride selenide. The result: a device that conducts electricity and insulates against heat transfer better than anything ever seen. Way better – it's 2.5 times more efficient and 23,000 times faster than the stuff it replaces. At 25 percent efficiency, the new coolers open a world of practical possibilities. "We've created the most compact and perhaps fastest refrigeration device in the world," says Rama Venkatasubramanian, who led the group in North Carolina. "With this, we can fully realize the power of existing technologies and provide entirely new capabilities."

The potential is huge. The materials can be fashioned into tiny heat pumps that will spot-cool processors. Microscopic cooling and heating can be put to use in biotech to regulate the localized temperature changes on DNA microarrays. The new system's ability to generate electricity could capture enough energy from a car's excess heat to power fuel-cell batteries and run the air conditioner.



King of the chill: RTI's Venkatasubramanian.

Less exotic applications – such as refrigerators and home heating and cooling – are further off. But Venkatasubramanian says he's making progress on them, too. "At this point, we've got a very good material in one layer of the lattice," he says. "We still have to improve the other layer, the device design, and the manufacturing issues. That's where the big payoff will be." This time, it shouldn't take 40 years.

– *Wil McCarthy*

The Edible Patent Boom

To some environmentalists, they're frankenfoods: dangerous superplants spawned by scientists run amok. To the US Supreme Court, they look like innovation. The court in December upheld the right of agribusiness to patent hybrid and genetically modified varieties of plants. The decision was a victory for DuPont, a major producer of seed corn and other reengineered edibles. It also validated some 1,800 plant and plant-process patents awarded to universities and corporations like Monsanto, Dow AgroSciences, and Syngenta. Here are some samples from this monster industry.

- *Laura Bradford*

GOLDEN RICE

In January 2001, Swiss and German scientists unveiled this health-boosting rice after implanting two genes from a daffodil and one from a bacterium in a common japonica rice called Taipei 309. The three genes give the rice seeds **an ability to produce beta-carotene**, a source of vitamin A. In the developing world, vitamin A deficiencies cause thousands of deaths and cases of blindness each year. Monsanto, Syngenta, Bayer, and others donated their patented technologies to the research effort. They're taking credit with a worldwide publicity campaign aimed at promoting health – and winning over a public that's queasy about biotech. Although **the rice will be licensed free of charge** in the developing world, Syngenta owns the right to exploit it commercially elsewhere.

Potential US market: $1 billion

PHOTOGRAPHS FROM LEFT: CHARLIE BROWN; COURTESY PETER BEYER, UNIVERSITY FREIBURG, GERMANYIMAGES

EXTRA-FIRM TOMATOES

It could bring an end to watery ketchup. The Agricultural Research Service, a division of the US Department of Agriculture, has applied for a patent on its process for cultivating tomatoes that are **up to 40 percent firmer than average**. Researchers isolated the genes responsible for an enzyme that removes galactose residue from plant walls. This sugar plays an important role in helping cell walls retain structural integrity. By reversing the gene sequence that leads to the breakdown of galactose, the tomatoes remain firmer longer and can be left to ripen on the vine without fear they'll spoil before reaching the market. Such tomatoes are also **useful for making thicker processed foods** like ketchup and tomato paste. The ARS plans to license the technology.

Potential US market: $660 million

DECAF COFFEE BEANS

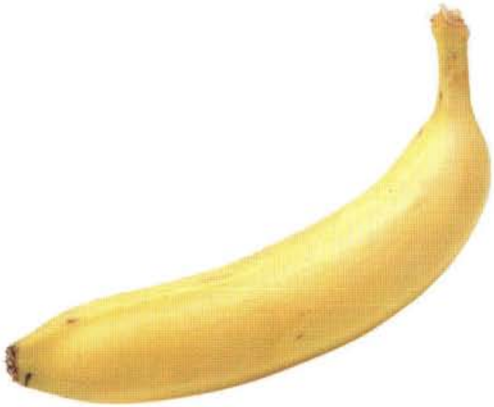
Forget water process. Researchers in Japan have isolated and cloned a gene for caffeine synthase, an enzyme that catalyzes the final steps of caffeine production in young tea and coffee plants. By suppressing this gene, they hope to create decaffeinated tea leaves and coffee beans. Such varieties are still a few years away but could produce decaf coffee with **the same flavor and aroma as leaded** versions. It's one biotech invention that could help you sleep sounder.

Potential US market: $400 million

BUG-FREE CORN

Monsanto's Roundup Ready/YieldGuard corn is known as a "stacked trait" transgenic because it contains more than one genetically engineered feature. Not only does it have built-in tolerance for Monsanto's Roundup herbicide, it also produces an insecticidal protein, derived from the bacterium *Bacillus thuringiensis*, that renders it **fatal to corn borer larvae**. The herbicide resistance allows for direct application of Roundup, which controls 145 different weed species. The genetically created resistance to corn borers reduces the need for topical pesticides. The variety, **used in processed foods and for animal feed**, was introduced in 2000 and planted on more than 140,000 acres in the United States. In 2001, Monsanto estimates, more than 1 million acres of corn were borer-free and Roundup ready.

Potential US market: $18.6 billion



EXTRA-RIPE BANANAS

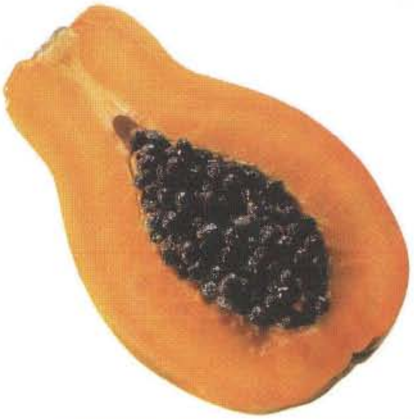
Extra-ripe fruit first appeared in grocery stores in the mid-'90s in the form of a big juicy tomato. Now the technology is coming to bananas, **the world's most popular fruit**. DNA Plant Technology's patented recombinant DNA process controls the expression and activity of ACC synthase, and therefore ethylene, the protein that stimulates ripening. The genetic coding suppresses ethylene production as the fruit reaches maturity, allowing it to be **left to grow sweet on the plant longer** and still have a long shelf life. DNAP hopes to put its extra-ripe bananas in supermarkets soon.

Potential global market: $5 billion

GIANT LETTUCE

Seminis' Sharpshooter iceberg was 10 years in the breeding, but in the end it's a big success. Really big. Patented in 1999, Sharpshooter is **40 percent heavier than other icebergs**. Scientists used traditional crossbreeding to mate a lettuce called El Toro (known for vigorous growth) with Montello (prized for resistance to corky root rot, a common scourge in California). The hybrid was then crossbred with another strain that's resistant to downy mildew. In each generation, 1 to 15 lucky offspring were selected to self-pollinate, reinforcing the desired traits in the next generation – until Sharpshooter emerged. The patented salad-bar staple **tastes like any other iceberg – just OK** – but it's cheaper to grow.

Potential US market: $1 billion



VIRUS-RESISTANT PAPAYAS

An added gene makes these SunUp papayas **resistant to the ring spot virus** that decimated Hawaii's crop in the early '90s, causing the fruit to end up shriveled and covered in brown spots. Using recombinant DNA techniques patented by Monsanto and Cornell University, researchers isolated and cloned a gene that controls the production of the virus' coat protein. When this gene was shot into papaya tissues, it caused the plants to overproduce and then suppress this protein, leaving the virus unable to reproduce. Resistant cells were then bred into existing papaya lines. The SunUp and its cousin, the Rainbow, make up about half of the papayas grown to maturity in Hawaii.

Potential US market: $16 million

PHOTOGRAPHS CLOCKWISE FROM TOP LEFT: FELICIA MARTINEZ/PHOTO EDIT/PICTUREQUEST; DAVID BISHOP/FOODPIX; EISENHUT & MAYER/FOODPIX; BRIAN LEATART/FOODPIX; COURTESY SEMINIS VEGETABLE SEEDS; BURKE/TRIOLO PRODUCTIONS/FOODPIX

Globocop

WHO: Ronald Noble, first American (and the first non-white guy) to head Interpol, the international police agency based in Lyon, France.

STRATEGY: Noble, 45, is building the first networked database to trace wanted criminals and illegal passport holders worldwide. "There needs to be a connection between databases of fugitives or alleged terrorists," he says.

BRAGGING RIGHTS? Interpol issued the first arrest warrant for Osama bin Laden – in 1998. Embarrassing caveat: Terrorist-harboring Libya requested it.

G-MAN: As US Treasury Department undersecretary, Noble once oversaw the Secret Service, the Customs Service, and the Bureau of Alcohol, Tobacco, and Firearms. Last year, his name was floated as a contender to head the FBI.

GETTING THE BAD BUYS: The September 11 attacks boosted Noble's overhaul of the stodgy 78-year-old agency. The new Interpol, he says, is open 24/7 and all about terrorism: "This is the kind of crime that Interpol needs to focus on nonstop." – *Mickey Butts*

The Man With the Golden Thumbs

WHO: Johnathan Wendel, world's highest-paid videogamer.

IN DEMAND: The 21-year-old is negotiating a deal to play in the first pay-per-view videogame match this spring. "The thing about gaming is it actually is exciting to watch," he says. "Kids our age see how we play, and they're like, 'Whoa, that's how to do it.'"

START BUTTON: Wendel went crazy for interactive mayhem in 1985 with the debut of the first Nintendo console. He mastered deadly combo moves with *Mortal Kombat*, making him nearly invincible. His nom de guerre: Fatal1ty.

BLING-BLING: Wendel sealed his rep by leveling the *Quake III* competition 18 to 0 at the 2000 World Cyber Games in Sweden. Last year, his agent negotiated a six-figure spokesgamer deal with Razer, a computer mouse maker.

HOME TURF: When not in South Korea or Europe whupping other pro gamers, he lives with his father in Lee's Summit, Missouri. – *Sonia Zjawinski*

Puff Daddy

WHO: Brack Hattler, executive director of the Artificial Lung Lab at the University of Pittsburgh Medical Center.

QUEST: To be the Jarvik of the lung. Since 1984, Hattler has been developing a mechanical implant that oxygenates blood in patients with respiratory trauma.

THINK SMALL: Conventional oxygenators draw a patient's blood outside of the body, run it through gas exchangers and heaters, and pump it back in. Result: torn red blood cells and a fatality rate as high as 50 percent. The Hattler Respiratory Catheter is threaded through a vein and into the heart's right atrium, where the process is gentler. A thousand hollow fibers wrap around a rapidly inflating and deflating balloon, forcing the exchange of oxygen and carbon dioxide.

THANKS, SADDAM: The Department of Defense backed Hattler's research in the early '90s when it learned Saddam Hussein had chemical and biological agents that could cripple the lungs.

PUT TO THE TEST: Human trials are scheduled for fall 2002, "which is the goal we had 15 years ago," says Hattler, 66. "We've finally gotten there." – *Mark Frauenfelder*

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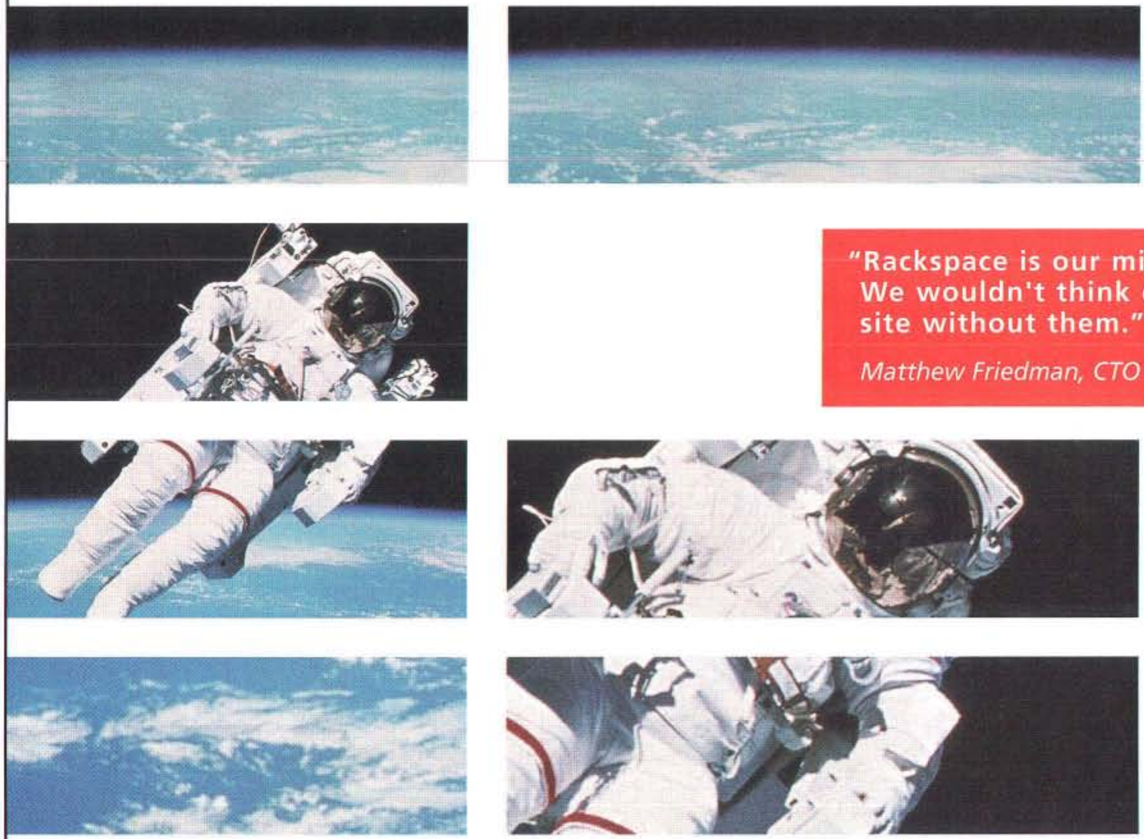

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JARGON WATCH

CPIP
Short for Carrier Pigeon Internet Protocol. Using birds to send datagrams from one network node to another, where they are scanned and sent on electronically. A group of Norwegian Linuxheads pulled it off. Why? Because they could.

Hackademy
A school – recently opened in Paris and currently under police surveillance – that teaches students how to break into computer systems.

Wetware Exploits
Human weaknesses that can be taken advantage of to hack or sabotage computer security systems. As in, "No system is immune to wetware exploits" (Slashdot). Also a type of email-borne virus in which the user is the destructive agent. A warning message tells the user to search out and remove a virus file. The file is usually a component of the Windows OS, so its removal causes system damage.

Smart Border
Name given to a new initiative to upgrade border surveillance technologies and procedures in light of terrorist traffic between Canada and the US.

– *Gareth Branwyn*
(jargon@wiredmag.com)

Extremists of the World, Unite

POLITICS Terrorism makes strange bedfellows. Consider the winding path of a speech written by America's leading neo-Nazi, William Pierce. An excerpt from his anti-Israeli rant, "The Value of Truth and Righteousness," ended up on the Web site of Hezbollah, the militant Islamic organization in southern Lebanon. Pierce, author of *The Turner Diaries*, also preaches that every Arab should be forced out of North America (along with Hispanics, blacks, and, of course, Jews). But that doesn't seem to bother Hezbollah. The organization, which has sponsored terrorist attacks in Israel, has at least two things in common with Pierce's National Alliance: hatred of Jews and deep suspicion of the US government. Here's how Pierce's speech made its way to the Middle East. – *Ted Rose*

Target practice: William Pierce.

On the street: Hezbollah demonstrators.

From Neo-Nazi Rant …

1. During the week of November 12, Pierce drafts a 3,340-word speech on a PC located on the first floor of the National Alliance headquarters in Hillsboro, West Virginia. The point of the speech: If Bush wants to wage war on terrorists, he should start with Israel.
2. Pierce heads to the second floor of the headquarters, where a National Alliance engineer uses a Dell 600 and Cool Edit software to record him reading the speech. The engineer creates a WAV file and emails the text and voice versions to webmaster Evelyn Hill.
3. In California, Hill edits the WAV file using Sound Forge. She posts the voice and text files on the group's host servers: QuikNet of Sacramento, California, and BitShop of College Park, Maryland.
4. On November 17, the speech is distributed worldwide to about 5,500 National Alliance listserv subscribers.

… To Hezbollah Homepage

5. The speech reaches Hezbollah, possibly through National Alliance members the group claims are based in Lebanon.
6. A Hezbollah representative excerpts 641 words of Pierce's speech. The only editorial change: Every reference to Israel is placed in quotes. Sample: "The prime minister of 'Israel,' Ariel Sharon, is a war criminal, a mass murderer, with the blood of thousands of women and children on his hands."
7. The excerpted speech is sent to the site of the Islamic Resistance Support Association (*www.moqawama.tv*), the online home for Hezbollah's background information and opinion articles, where it is coded in HTML. The Web page is hosted by Cyberia, Lebanon's leading ISP, located on the capital's main thoroughfare, Hamra Street, Beirut.
8. It's posted online November 24 and viewed by an estimated 6,000 to 8,000 readers, in both English and Arabic. Roughly 85 percent of the visitors are outside of the Middle East.

PHOTOGRAPHS FROM LEFT: LAWRENCE W. MYERS; AFP PHOTO/ALI DIYA

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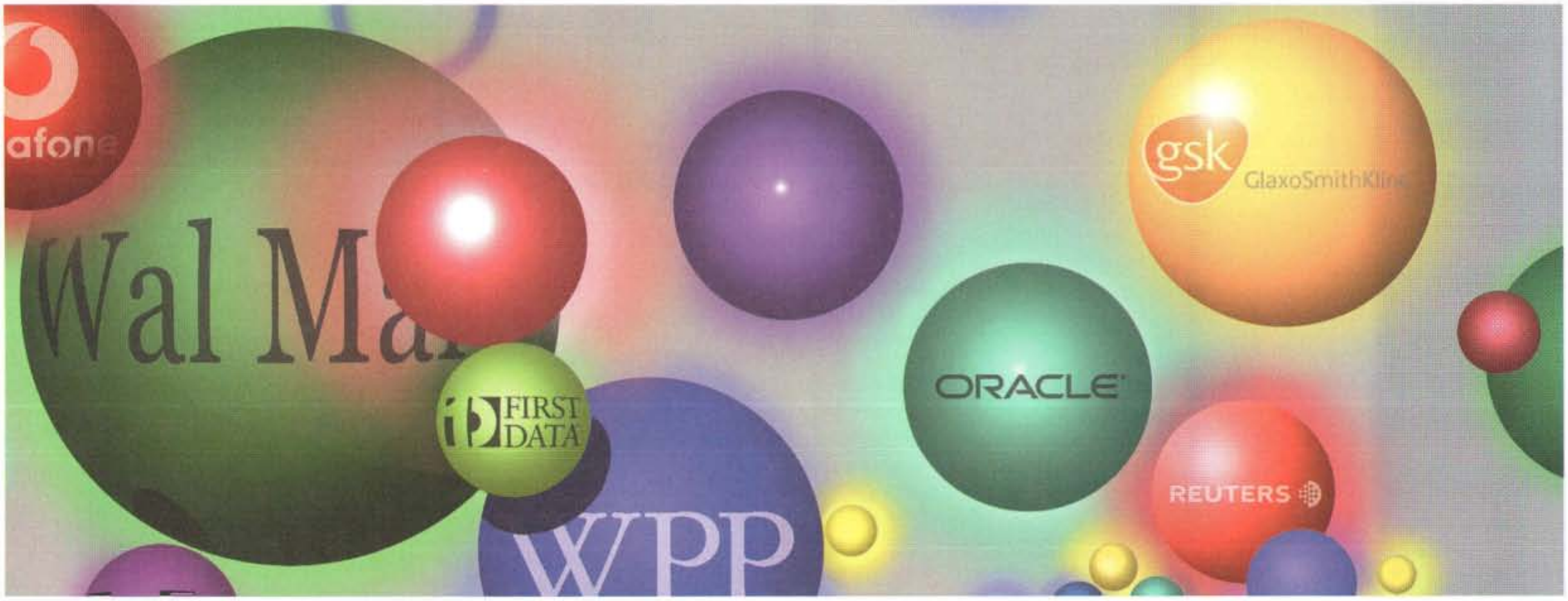

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Out of the Ordinary

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A Spoonful of Poison

By Chris Anderson

When Lord Kelvin spelled out the second law of thermodynamics in 1850, the bit about entropy got all the press. In Victorian England, a fertile ground for hysteria, the notion that eventually everything falls apart struck a morbid chord. Etchings of shivering families, dressed in rags and huddling in a frozen landscape, illustrated scientific explanations of the "heat death of the universe." Brrr. What could be scarier?

Deflation, that's what. That term, too, is steeped in disintegration and despair, conjuring up a world where products and services lose value with each day – commercial entropy. The difference is that deflation is not a scenario in theoretical physics, but something that haunts the world today. Japan has been deflating since the late 1990s; Hong Kong, Taiwan, and Argentina have joined it over the past year. When US price indices started to fall in late 2001, economists worried that even the world's largest economy might not be immune. Such miserable talk crops up in every seriously down market, and for good reason: the horrifying example of the Great Depression, when prices fell by 25 percent and a quarter of the workforce was left on the streets. Today, the threat of such big-*D* deflation in America is far more remote. But another more benign kind of deflation is here to stay as a fundamental element of the new economy. The carrier of this little-*d* deflation is technology.

Deflation may sound scary, but a little can be a good thing.

The difference between the two is that technology-driven deflation affects only some parts of the economy, while big-*D* deflation is felt across the board. Big-*D* can take the economy into depression. Little-*d* just tends to keep inflation in check, while enhancing overall growth.

Tech deflation came of age along with the microchip. When, as Moore's law ensures, the price of a million calculations falls to half of what it was 18 months ago, something in the real world also gets cheaper. This is where the digital revolution gets its power: The cheaper things are, the more they spread and the greater their impact. Were DVD players too expensive for you during Christmas 2000? They probably weren't in 2001 (bye-bye, VHS). This is true for digital cameras and virtually everything else with silicon in its soul.

Commodity prices have been falling as well, in part because technology allows companies to find and extract everything from oil to ore more cheaply. Technology can augment and replace people in service industries, cutting prices there, too: Look at anything from brokerage fees to automated call centers. And technology accelerates globalization, allowing manufacturers to take better advantage of cheaper foreign labor.

The results are striking, and mostly welcome. Consumers get more for their money, effectively increasing real earnings. Within companies, getting more for less leads to higher productivity. And higher productivity is the single strongest factor in economic growth. This is where Alan Greenspan got his confidence in the new economy; so far, despite the slump, the evidence still seems sound.

Living with deflation is nothing new to most tech companies; it is the natural state of sectors from telecom to consumer electronics. Cisco and Nokia are case studies in the profits to be found when cheaper products expand markets, reaching more consumers. Companies adapt to shortening shelf lives by accelerating innovation and build-to-order production – Dell may be the most deflation-hardened firm on earth, and it's better for it.

Could little-*d* turn into big-*D*? Absolutely. Consider the scenario of a weak economy with plummeting consumer confidence. Buyers know most things will only get cheaper, so they defer purchases. Inventories pile up and cause more price cutting. Corporate profits shrink and stock markets fall. GDP growth follows, and the economy sinks first into recession, then depression. Debt turns crippling, as old loans are repaid with ever-more expensive dollars. Companies lay off workers, and the cycle turns vicious.

This is what makes Japan such an unhappy place at the moment. But America is in far better shape. Countering the deflationary effects of technology are two equally important components of the economy, both of which tend to be inflationary: Wages tend to rise, since employees won't stand for salary cuts. And property, a limited resource, tends to appreciate over time. Japan went wrong by allowing a corrupt and inefficient banking system to fuel a property bubble. America's excesses do not compare.

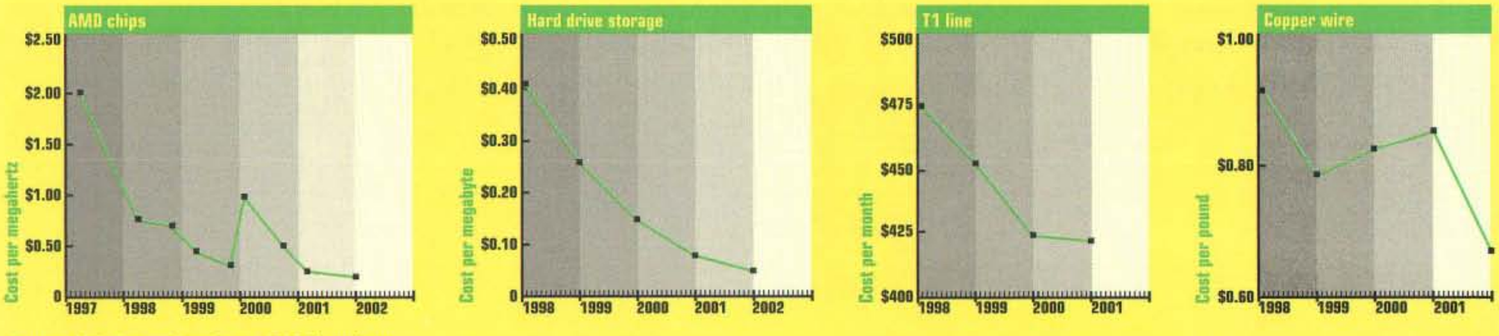
After the Victorians got over the bleak entropy aspects of thermodynamics, they started looking at the rest of the heat laws. They found the physics that led to the internal combustion engine. In today's rethinking of deflation may lie the seeds of a new economic machine every bit as productive. ■ ■ ■

Chris Anderson (canderson@wiredmag.com) *is* Wired's *editor in chief.*

WIRED INDEX

Lower Prices, Better Stuff

Technological progress usually brings lower prices – and not just in DVD players. Here's a quick survey of price trends for various commodities and products.



Sources: AMD, Gartner Data Group, AT&T, Bloomberg

It's not often a two-hour ride lasts a lifetime.

Talk to most motorcyclists, and they'll tell you how one ride can get inside you, and stay with you forever. This same phenomenon happens on another level at every *Ride for Kids*® event. Each ride works to improve the lives of kids who have been diagnosed with childhood brain tumors by raising funds for medical research.

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With Honda's support, more than 10,000 motorcyclists devote their time, money and energy to the *Ride for Kids* program every year. Yet everyone's goal of finding the cause of childhood brain tumors, and discovering a cure, remains many rides away. Which is why Honda continues to nurture this program. Because, while the ride lasts only a day, it leaves us with hope that lasts a lifetime.

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Pictured: Juston Smart and his dad, Jeff. Juston is a brain-tumor survivor and supporter of the *Ride for Kids* program. For more information, call the Pediatric Brain Tumor Foundation of the United States at 1-800-253-6530, or visit pbtfus.org.

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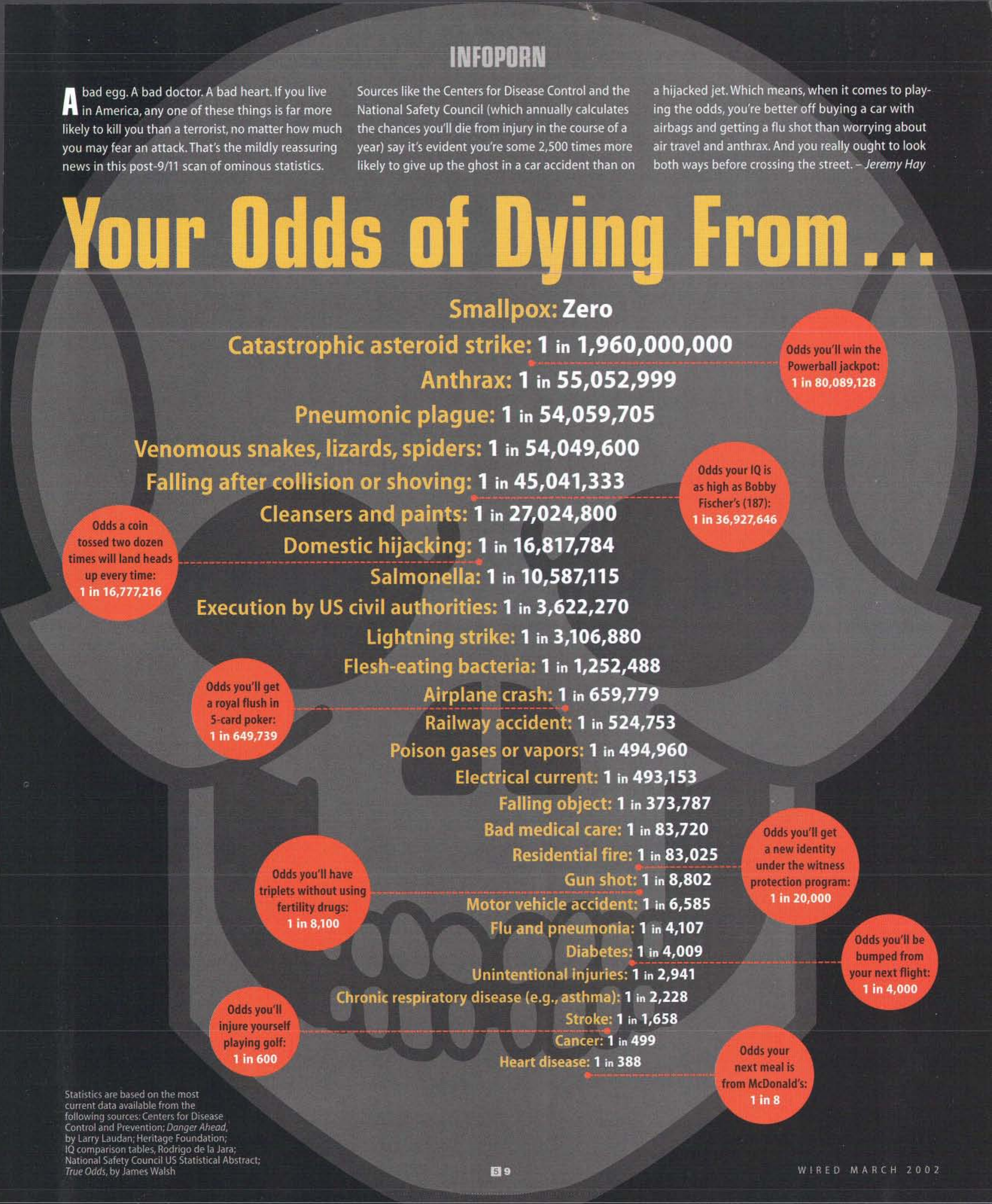
A bad egg. A bad doctor. A bad heart. If you live in America, any one of these things is far more likely to kill you than a terrorist, no matter how much you may fear an attack. That's the mildly reassuring news in this post-9/11 scan of ominous statistics. Sources like the Centers for Disease Control and the National Safety Council (which annually calculates the chances you'll die from injury in the course of a year) say it's evident you're some 2,500 times more likely to give up the ghost in a car accident than on a hijacked jet. Which means, when it comes to playing the odds, you're better off buying a car with airbags and getting a flu shot than worrying about air travel and anthrax. And you really ought to look both ways before crossing the street. – *Jeremy Hay*

Your Odds of Dying From . . .



Smallpox: Zero
Catastrophic asteroid strike: 1 in 1,960,000,000
Anthrax: 1 in 55,052,999
Pneumonic plague: 1 in 54,059,705
Venomous snakes, lizards, spiders: 1 in 54,049,600
Falling after collision or shoving: 1 in 45,041,333
Cleansers and paints: 1 in 27,024,800
Domestic hijacking: 1 in 16,817,784
Salmonella: 1 in 10,587,115
Execution by US civil authorities: 1 in 3,622,270
Lightning strike: 1 in 3,106,880
Flesh-eating bacteria: 1 in 1,252,488
Airplane crash: 1 in 659,779
Railway accident: 1 in 524,753
Poison gases or vapors: 1 in 494,960
Electrical current: 1 in 493,153
Falling object: 1 in 373,787
Bad medical care: 1 in 83,720
Residential fire: 1 in 83,025
Gun shot: 1 in 8,802
Motor vehicle accident: 1 in 6,585
Flu and pneumonia: 1 in 4,107
Diabetes: 1 in 4,009
Unintentional injuries: 1 in 2,941
Chronic respiratory disease (e.g., asthma): 1 in 2,228
Stroke: 1 in 1,658
Cancer: 1 in 499
Heart disease: 1 in 388

Odds you'll win the Powerball jackpot: 1 in 80,089,128

Odds your IQ is as high as Bobby Fischer's (187): 1 in 36,927,646

Odds a coin tossed two dozen times will land heads up every time: 1 in 16,777,216

Odds you'll get a royal flush in 5-card poker: 1 in 649,739

Odds you'll get a new identity under the witness protection program: 1 in 20,000

Odds you'll have triplets without using fertility drugs: 1 in 8,100

Odds you'll be bumped from your next flight: 1 in 4,000

Odds you'll injure yourself playing golf: 1 in 600

Odds your next meal is from McDonald's: 1 in 8

Statistics are based on the most current data available from the following sources: Centers for Disease Control and Prevention; *Danger Ahead*, by Larry Laudan; Heritage Foundation; IQ comparison tables, Rodrigo de la Jara; National Safety Council US Statistical Abstract; *True Odds*, by James Walsh

DEAFENING DECIBELS

A guide to the eardrum damage in everyday life

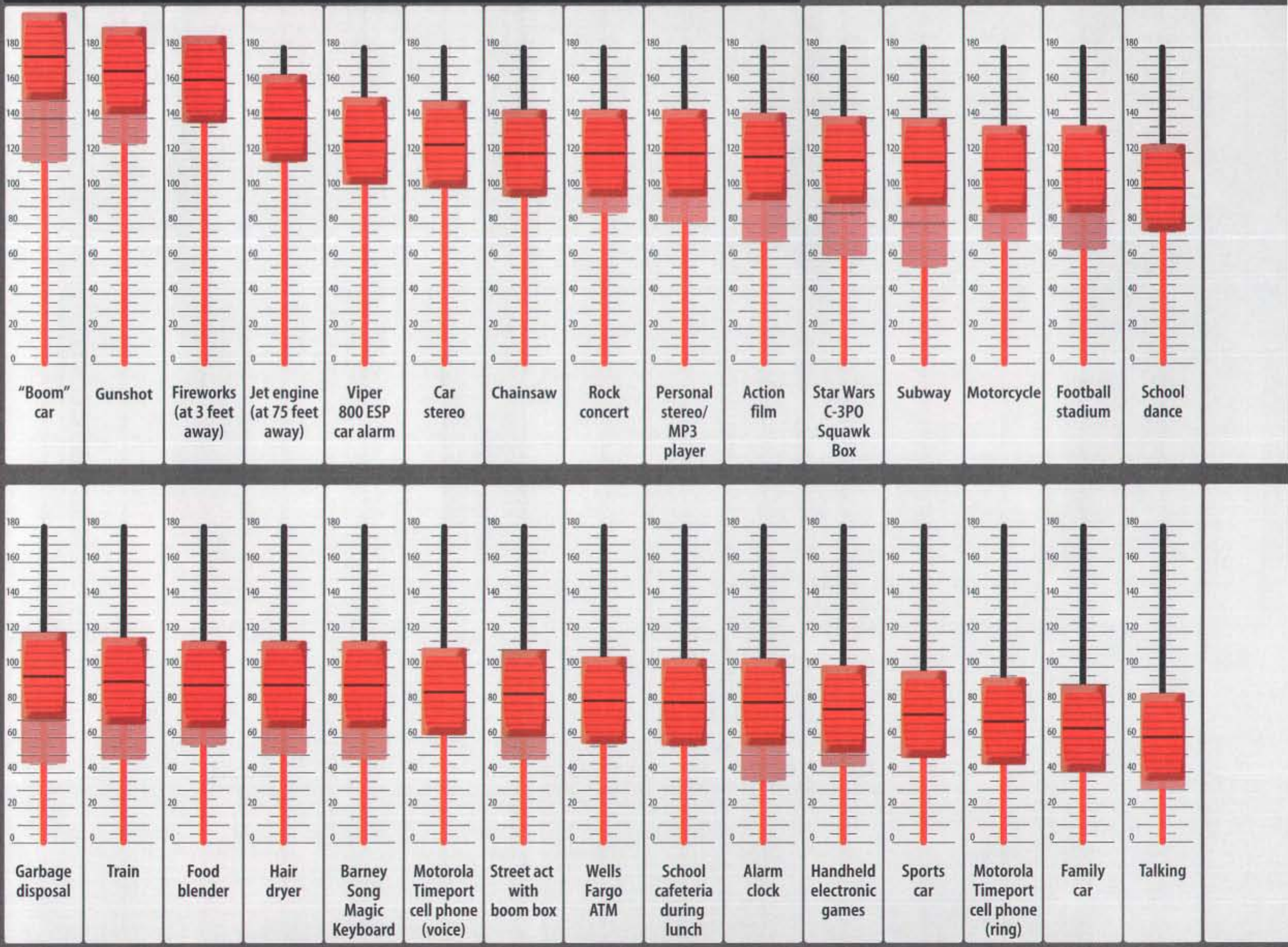
Ears still ringing from your Saturday night out? You're not the only one. Movies, restaurants, ATMs, toys, and MP3 players are needling our lives further into the red. More than half of the loudest sounds around us were introduced in the past decade. These so-called voluntary noises – sounds we choose (if only passively) – are often close to 85 dB, the point at which we risk hearing loss if exposed over an extended period of time. Add to that the general accumulation of noise – cell phones, car alarms, and lawn mowers – and you have a driving force behind today's hearing-aid industry. These days, doctors are finding more and more environmental hearing loss in teens.

On the bright side, technological advances have hushed up standard home appliances, including dishwashers and vacuum cleaners. And governmental regulations have helped to diminish workplace noise in the past 20 years. But OSHA, the EPA, and other regulators, such as the Consumer Product Safety Commission, steer clear of making rules for nearly all voluntary noises. Why? When it comes to most consumer and environmental noise, there are just too many factors to regulate.

Nancy Nadler, director of the Noise Center in New York, says it's easy to underestimate just how loud our lives are, because most of us think of noise as a sudden and short-impact event. "The argument is that people are only going to the movies for an hour – so what if it's 100 dBs?" she explains. "But the problem is the accumulation of all that noise – from the gym, the Discman, the restaurants – day after day." – *Gil Kaufman*

What's making all that noise: some examples

All charts in decibels

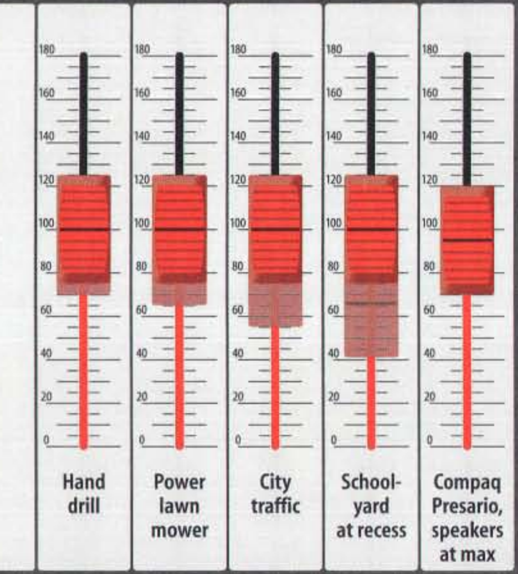


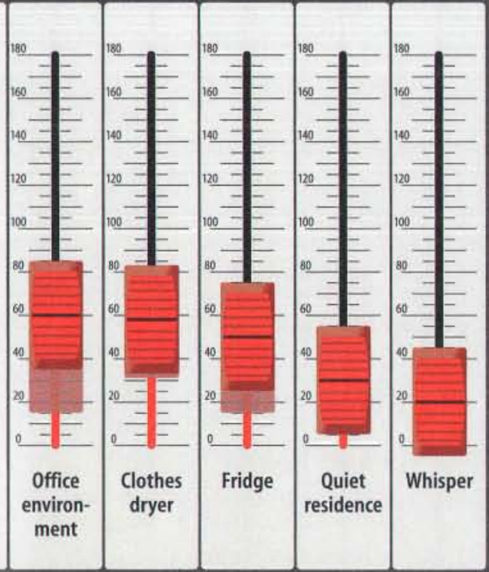
Decibels: what is too loud?

NOISE LEVEL	LENGTH OF EXPOSURE BEFORE YOU RISK HEARING LOSS
140–175 dB	0.5 seconds–30 seconds
130–140 dB	30 seconds–2 minutes
110–130 dB	2 minutes–30 minutes
100–110 dB	30 minutes–2 hours
80–100 dB	2 hours–16 hours
56–80 dB	> 8 hours
< 56 dB	Indefinite

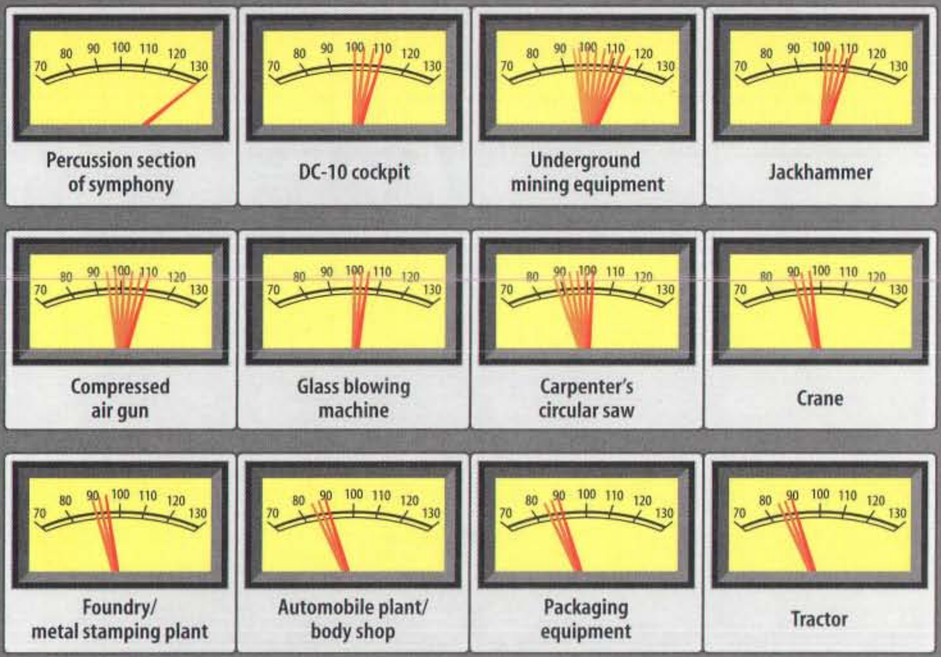
NOISE LEVEL	PHYSICAL EFFECTS
140–150 dB	Ear pain
> 85 dB	Hearing loss, temporary or permanent
> 55 dB	Outdoor annoyance
> 45 dB	Indoor annoyance

CHANGE IN LEVEL	SUBJECTIVE LOUDNESS
+/– 1 dB	Imperceptible
+/– 3 dB	Barely noticeable
+/– 6 dB	Clearly noticeable
+/– 10 dB	About twice (or half) as loud

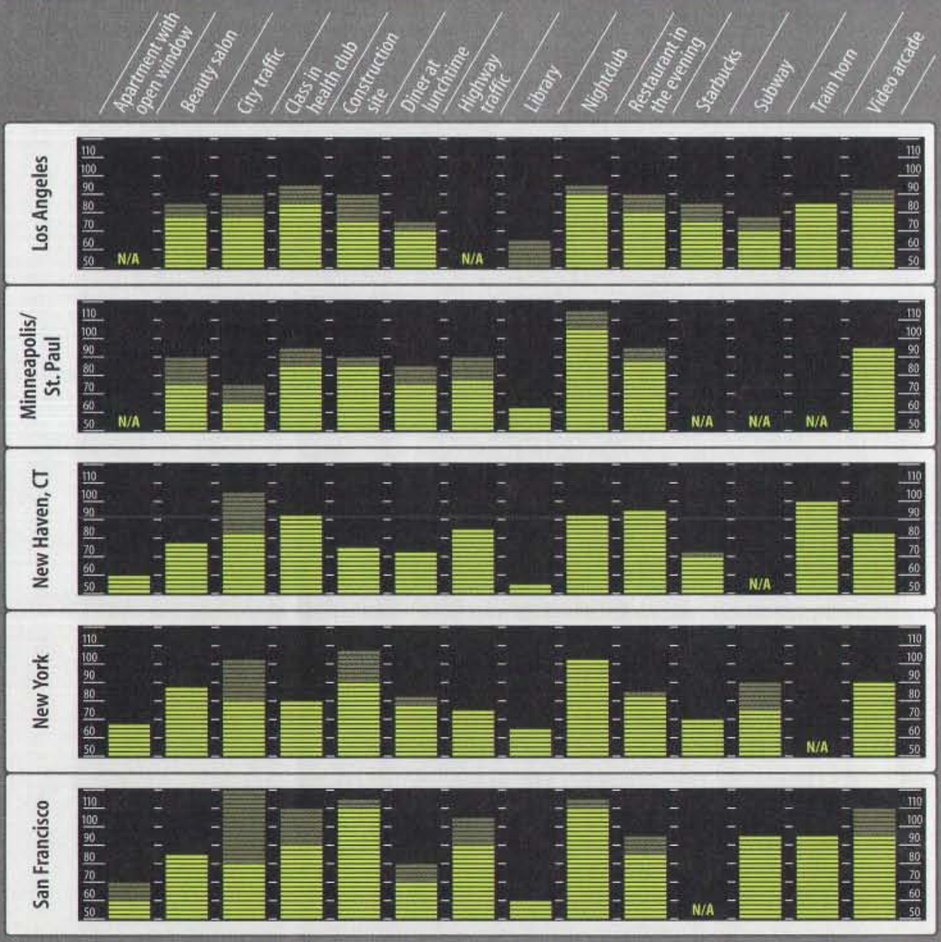




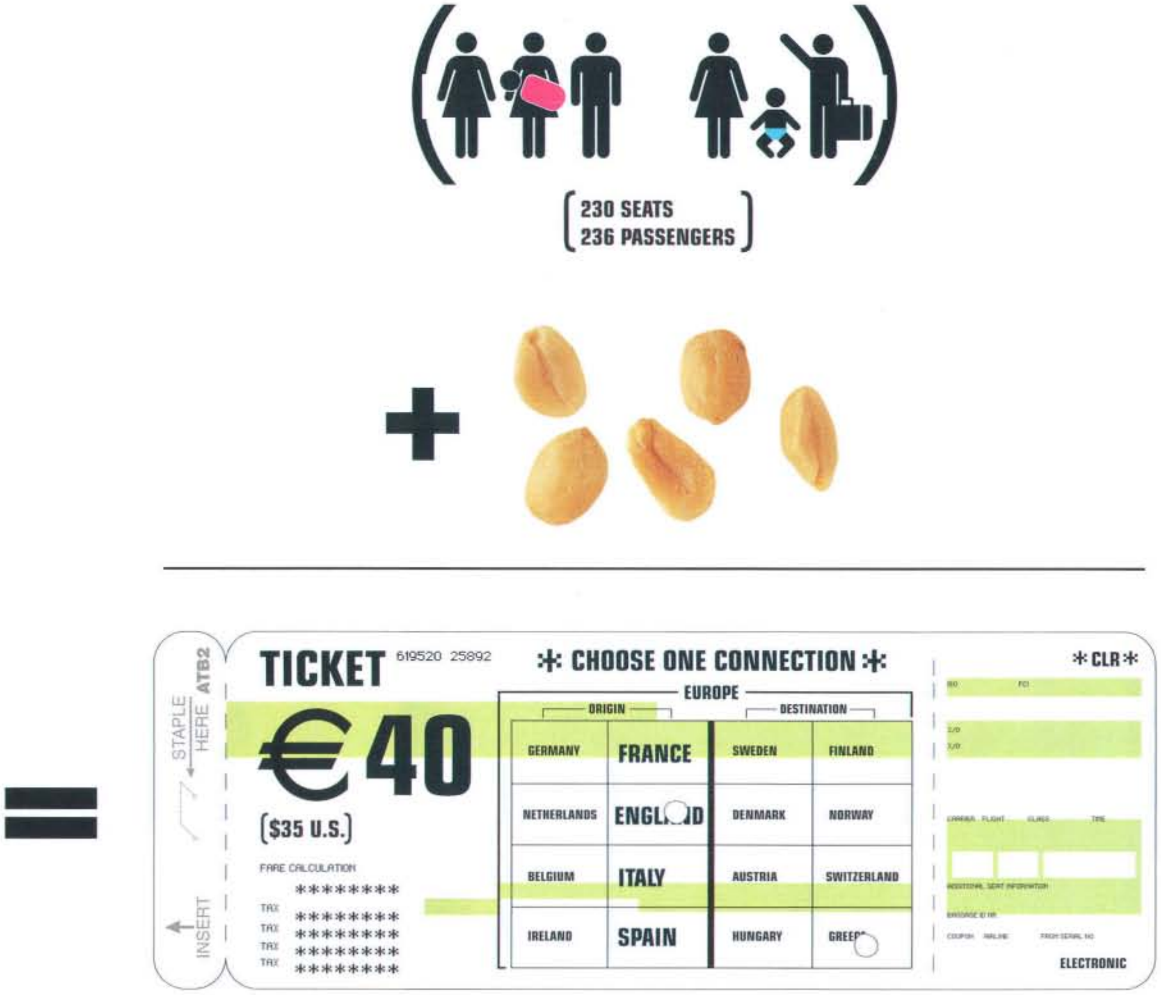
Bring your earplugs: volume in the workplace



City by city: variations in noise



Sources: Acoustics.com; *Architectural Acoustics*, M. David Egan; Associates in Acoustics; Center to Protect Workers' Rights; James, Anderson and Associates; League for the Hard of Hearing; OSHA; Noise Center; National Campaign for Hearing Health; Noise Pollution Clearinghouse; Shen Milsom & Wilke/Paoletti; US Public Interest Research Group



Fast, Cheap & Out of Control

How Europe's deregulated airlines are using cut-rate fares, Web engines, and small airfields to shake up the flying game. **By B. A. Warner**

When I reserved my seat on Ryanair flight 125 between London and Alghero, Italy, a few weeks after the terrorist attacks – on the day that the US began raining bombs down on Afghanistan – I planned on a bit of room to stretch out. All over the world, people were avoiding air travel, forcing airlines to fire thousands of workers, cancel flights, and even declare bankruptcy. Little did I know that I had booked what appeared to be the toughest airline ticket on the planet. The plane was overflowing. The final passengers down the jetway were even asked to take the seats usually reserved for flight attendants.

Was it the lure to so many rain-soaked Londoners of a sun-baked Italian coast? Or a massive retreat to a remote town in a time of war? Nope. It was the price tag. Alitalia charges $300 for the trip. On Ryanair, I paid $35. Thanks to such fares, Ryanair planes are flying at or near capacity all over Europe. Last August, the Dublin company logged its first-ever million-passenger month. And its biggest low-cost competitor, easyJet, is faring nearly as well. Overall passenger volume for European carriers declined almost 20 percent in November, according to the Association of European Airlines. November ridership on easyJet, by contrast, increased 39 percent, with its planes averaging 85 percent capacity.

Even more amazing, both companies are making money. Last year, British Airways lost $1 billion on $13 billion in revenue. With $500 million in revenue, easyJet is obviously a much smaller business, but its 2001 profits spiked 82 percent to almost $60 million. Ryanair did even better. It made $117 million, and for a short spell even passed Lufthansa's $4.5 billion market cap to become Europe's biggest airline. In January, shares in both airlines were trading near 52-week highs. "By 2004, we expect to see 14 million passengers a year," says Sean Coyle, commercial director of Ryanair's Internet operation. "That would put us fourth [in Europe], behind only British Airways, Air France, and Lufthansa."

The reason for the success of easyJet and Ryanair is partly economic. In a downturn, passengers of course flock to low fares. But profits don't naturally flow from rock-bottom prices. To make money, the budget airlines are outperforming their larger rivals. They've used the recent deregulation of Europe's skies as an opportunity to rethink Southwest Airline's decades-old low-cost template, adding technology and some creative thinking to uncover new revenue streams, master yield management, and minimize time on the ground.

Analysts see easyJet and Ryanair growing 20 to 25 percent annually over the next five years, all within Europe – on the same intracontinental routes that have befuddled the nationals. "In 10 years' time, the large long-haul carriers will no longer be flying within Europe," predicts easyJet CEO Ray Webster. "We're the ones that will survive."

Not without a fight from the nationals. They're discounting, throwing in bonus miles, and offering package deals as ways to lure back customers. BA turned inward to conduct its so-called Future Size-and-Shape Project in search of crafting a more efficient operation. Aer Lingus, Alitalia, and Olympic all queued up for reorganization. And Lufthansa went on the attack. After Ryanair opened a hub outside Frankfurt, the German airline filed suit against Ryanair for unfair advertising practices.

While other carriers are reeling, Ryanair and easyJet are **piling up profit** – and analysts see 20 to 25 percent growth for the next five years.

Some critics say there's only so much room for the budget carriers to grow. The field has become more crowded with the recent additions of Go, a carrier originally founded by BA that was spun off last summer, and Buzz, an offshoot of Dutch national KLM. Any more players, and the whole lot could soon start to feel the heat of an overserved market. They may also represent merely a transitional model. Once the dying European flag carriers shake out – as Sabena and Swissair already have – those remaining will be in a much better position to compete.

But until then, while the majors busily reinvent their businesses, the low-cost airlines are remaking the European continent. The euro is eroding geographic boundaries and provincial barriers while increasing the need for cheap, reliable transportation links. High-speed rail lines do well connecting hubs, but they exclude many cities. With the European Commission newly committed to ending government bailouts for the airlines, there are no more walls to keep the budget carriers from making further incursions in Europe.

The notion of low-cost airlines is hardly new. People Express has been out of business longer than it existed, but it lives on in the memories of many for the way it slashed fares and kept customers lined up for hours in a quest for an unassigned seat. Founded in 1980 with a handful of planes, People Express quickly grew to become the fifth-largest commercial carrier in the US, with 4,000 employees and more than 70 aircraft. But it never saw much in the way of profits – primarily because it suffered from high labor, marketing, and maintenance costs – and as it expanded, things only got worse. In 1983, the airline netted $10 million on $287 million in revenue. In 1986 – the year it filed for Chapter 11 – it was projecting a $200 million loss on more than $1 billion in revenue.

But the failure of People Express wasn't a failure of the low-cost concept. Today's budget carriers enjoy two important advantages that People Express never had – the Internet and some lessons gleaned from the rise of Southwest Airlines. Southwest existed in the early '80s, but only as a niche carrier. Since then, it has applied a simple, inexpensive template to become the fifth-largest airline in the US: Fly one class of jet (to save on parts and training) into secondary airports (to save on the large slotting fees charged at bigger airports), and forget about catering (to save meal costs and time on the ground). And the model still works. Southwest continues to do well in the face of its rivals, and it has even inspired competitors in the US, most notably the 2-year-old JetBlue, which turned a profit in the third quarter of 2001.

The European carriers are improving on the model by slashing costs even further and investing in technology. Ryanair solicited Germany's SAP in late 2001 to develop transaction software to help draw efficiencies out of its myriad supplier-vendor dealings. In turn, easyJet has pledged $10 million to help develop a new, satellite-guided trafficking system, which promises to improve landing-to-takeoff turnaround time. (Ryanair and easyJet both average about 25 minutes. The goal: Southwest's industry-best time of 15 minutes.) As one executive puts it, "You pay a hefty mortgage on these planes. The only way to pay for them is to use them."

One source of savings comes from the booking process. The budget carriers cater to a young, Internet-enabled clientele, nearly 80 percent of whom use the Web to buy tickets. This allows the airlines to minimize the use of ticketing personnel in favor of Web-based engines with real-time access to seat availability. As a result, Ryanair ditched its ties with travel agents last year and saved almost $9 million in six months.

The airlines have also managed to turn their Web sites into profit centers. The sites are virtual travel bazaars, spotlighting deals on hotels, car rentals, and travel insurance – all of which bring commissions to the airlines. Add the savings that come from employing nonunion labor and Ryanair breaks even on a flight once it hits 55 percent capacity, versus70-plus percent for the major carriers.

Unlike Southwest, Ryanair and easyJet save by shunning frequent-flier programs. Does that alienate customers? Ryanair has no idea – it doesn't spend on customer research, either. "We don't waste money," boasts Tim Jeans, Ryanair's head of marketing and sales. "One of the upsides of not doing any research: You never get bored." The end result is a 22 percent operations margin for Ryanair – 7 points higher than Southwest's.

With traffic and prices plummeting, Aer Lingus has cut flights from Dublin to Paris and London. **The nationals have lost** control of Europe's skies.

Perhaps most critically, the low-cost carriers are exploiting an abundance of underserved European airports. Ryanair periodically offers $9 one-way fares from London to Frankfurt. But in reality, the plane never makes it to Frankfurt. Instead, it flies into Hahn, 60 miles to the west. There, Ryanair pays much lower slotting fees. And the lack of congestion allows its planes to get back in the air quickly.

There are many remote landing strips like Hahn all over Europe. Many of them have seen little traffic since World War II and are actively courting the budget carriers with enticing packages. In some of the small markets Ryanair serves, which Coyle refuses to name, the airline has managed to do away with slotting fees entirely. It pays nothing when its planes touch down – an unheard-of benefit in the industry. Other airports have been even more aggressive. Late last year, officials in Brussels began looking into whether Belgium's Charleroi Airport gave Ryanair more than $2 million in perks in exchange for having Ryanair name Charleroi a new continental hub.

As far as the local politicians are concerned, such deals are a small price to pay to reawaken an economy. Simon Geere, business development director for London Luton Airport, easyJet's home base, estimates that signing Ryanair, which has several daily flights from nearby Stansted, could mean 200,000 to 300,000 extra passengers in the first year. "If you're a secondary airport," he says, "getting a low-cost airline can make or break your business."

In no position to win a brutal price war – because they're already losing money flying within Europe – the national carriers have begun to concede some short-haul routes. In December, analysts speculated that BA, facing a 10-month decline in traffic and price pressure, would reduce flights from Glasgow to London. (BA refused to comment while conducting its internal audit.) Aer Lingus has begun shelving flights from Dublin to Stockholm, Paris, and London. This is truly bad news for the nationals. With passengers shying away from transatlantic travel, the big carriers can't turn to intracontinental flights to bolster their business. They have become airlines with nowhere to fly.

If it seems like the budget airlines have come out of nowhere, that's not far from the truth. But why now? For starters, the terrorist attacks. "The September 11 tragedy has thrown us an opportunity, and we have taken advantage of that," says Ryanair's Tim Jeans. Since the attacks, Ryanair has purchased new aircraft, opened a new hub, and negotiated a new contract with its pilots. And easyJet has been equally aggressive. It completed a $150 million secondary offering in November to buy more aircraft and slots at Gatwick and Paris Orly airports. Both airlines have also found their advertising dollars working harder since September. But there's a deeper explanation for the rise of the budget airlines: deregulation.

Until the past quarter century, commercial airlines had been coddled by government-sanctioned protectionist pricing. In the US, the FAA and its predecessor, the Civil Aeronautics Board, maintained an iron grip on the airways, doling out routes to the elite few who could demonstrate an ability to transport people, and sacks of mail, safely. A few upstarts tried unsuccessfully to take on the majors in this environment. In 1978, the US deregulated its airways to spur competition. The early '80s brought reduced fares, a boost in ridership, the emergence of low-cost competitors and, eventually, the death of some majors, like Eastern and Pan Am.

Europe, by contrast, has been slower to open its skies. Some countries, including France, are just now privatizing. Even in Britain – whose industry was partially privatized 17 years ago – deregulation didn't have the same immediate effect as in the US. The reason is part politics and part geography.

The proximity of London to, say, Rome – roughly the distance from New York to Atlanta – should have made for a vibrant shuttle business, but it didn't. That's because while Britain was privatized, Italy was not. In a regulated environment, all home carriers – from flagship airlines like Italy's Alitalia to private carriers like British Midland – gets dibs on landing slots, whether or not they plan to use them. The flag carriers have also received a more explicit form of support. The governments have routinely staved off bankruptcy at their national airlines by infusing them with taxpayer money. Add it up and the nationals have controlled the European skies - setting fares and dictating which airlines could fly where.

In 1997, the final phase of deregulation took hold. In the EU, carriers would no longer be limited to routes that began or ended in their home country. In the years since, easyJet and Ryanair have accumulated nearly as much power over the skies as British Airways. And unlike BA, they're growing. An increased presence in Paris and London is the first step of easyJet's expansion plan for 2002. Same goes for Ryanair, which hopes to open in as many as 10 new markets this year and dig deeper in the markets it already serves.

Meanwhile, the European Commission has waged a campaign over the past few years to put an end to the bailouts. In the wake of September 11, the commission discouraged the Belgian government from saving Sabena, Belgium's largest carrier - stranding many passengers at the gate. The message was simple: The market should determine who thrives and who dies. Even the Bush administration's $15 billion in aid to US airlines couldn't sway the EU to look the other way. "Passengers cannot benefit when the national carriers are afforded the old level of protection," says one member of the commission's air transport committee.

In Nykoping, a sleepy Swedish seafaring community 60 miles south of Stockholm, the Ryanair effect is in full force. Skavsta, the local airport, is a real pip-squeak - even by Ryanair standards. A former military landing strip in the backend of nowhere, it has three gates, six public toilets, a small bar, a newsstand, and a gift shop - all crammed in a building the size of a high school cafeteria. When Ryanair started flying to Skavsta in 1997, it put Nykoping on the map.

The airline flies between Nykoping and the UK three times a day. As a result, the town has experienced a more sustained economic boom over the past three years than even Stockholm. The job market is healthy, and real estate is on the rise. New apartments, condos, and office complexes continue to pop up - alongside 800-year-old castles and noble estates.

Bo Hermansson, Nykoping's chief administrator, gives Ryanair partial credit for the revival. At first, Stockholm residents would drive through the region en route to the airport. Then they started buying property. A number of Brits have also purchased second homes. "Why not?" Hermansson reasons. "You are a one-hour drive from Stockholm or a two-hour flight from London."

Now Hermansson is wooing more low-cost carriers. "Expansion of the airport is an expansion of the town. It could be a good thing," he says, "as long as we control it."

No boom is all good. "We are flooded," says an official in overcrowded Nice. "You can't put 2 liters of olive oil in a 1-liter bottle."

The budget airlines are having a similar impact all over Western Europe. So many Brits are buying second homes in the famous wine-making region of Tuscany that some have jokingly renamed the area Chiantishire. Fashionistas now refuse to pay retail for Gucci in London when they can fly to Milan for a weekend, buy the real deal at the factory outlet, and take in a night of opera for roughly the same price.

With many young Europeans working abroad, the weekly commute between London and Rome or Nice has become common. Dublin, Amsterdam, Barcelona, and Ibiza have become the favored destinations for British bachelor parties and girls' nights out. "What they've done is bring peripheral regions - the UK, Ireland, and Scandinavia - into the European mainstream," says Nigel Dennis, an air transport research fellow at the University of Westminster in London.

Ryanair CEO Michael O'Leary says his company's brings both tourists and jobs. Stelios Haji-Ioannou, easyJet's colorful 35-year-old founder, goes even further. He says his airline is redistributing the population of modern-day Europe. "I meet a lot of people on our flights that don't have to make the stark choice between the sun in the south and business in the north," he says. "In the time of my father, this would have been impossible."

Of course, no boom is all good. Europeans are feeling the effects of commodified travel on the continent's fragile infrastructure. In the clubbing mecca of Ibiza, businesspeople love the budget airlines. Yet 30 years of mass tourism is clearly taking its toll on the white island. Much of the tap water tastes salty and has a funky odor - the result of seawater infiltrating the overused wells.

Many of Europe's older southern cities are woefully unprepared for an influx of people. Take Nice, the capital city of the famed Côte d'Azur, which can accommodate only 4 million visitors a year. "We don't want more people. We are flooded," says Bernard Morel, executive director for the city's convention and tourism bureau. "You can't put 2 liters of olive oil in a 1-liter bottle."

Some industry watchers think the budget phenomenon will be short-lived. Low prices, after all, can be a fragile proposition. "There is only so much room for so many cheap airlines," says Brian Simpson, a member of the European Parliament's regional affairs, transport, and tourism subcommittee.

If that's true, the thing that may undo the budget carriers could be the very dynamic that has most significantly propelled them to success. Like the People Express of old, these airlines clearly trade savings for quality of experience. Southwest famously reduced its perks to one measly packet of peanuts. On the European budget airlines, not even the peanuts are free.

Most flights - especially to sunny destinations - are packed, many with screaming kids and exasperated parents. Ryanair offers no assigned seats. On a flight out of Alghero, Italy, last summer, I witnessed in amazement a mob of ticketed passengers, more than 40 people wide, ignore orders announced over the intercom to let children and parents board early. To say it's the Greyhound bus crowd with double the waiting time is being somewhat unkind to Greyhound.

"My experience with Ryanair reminded me very much of a stampede," says European diplomat Simpson. "Anybody who was half a second slow was mowed down trying to get on the airplane. You get what you pay for."

And sometimes, that's exactly what you want. ■ ■ ■

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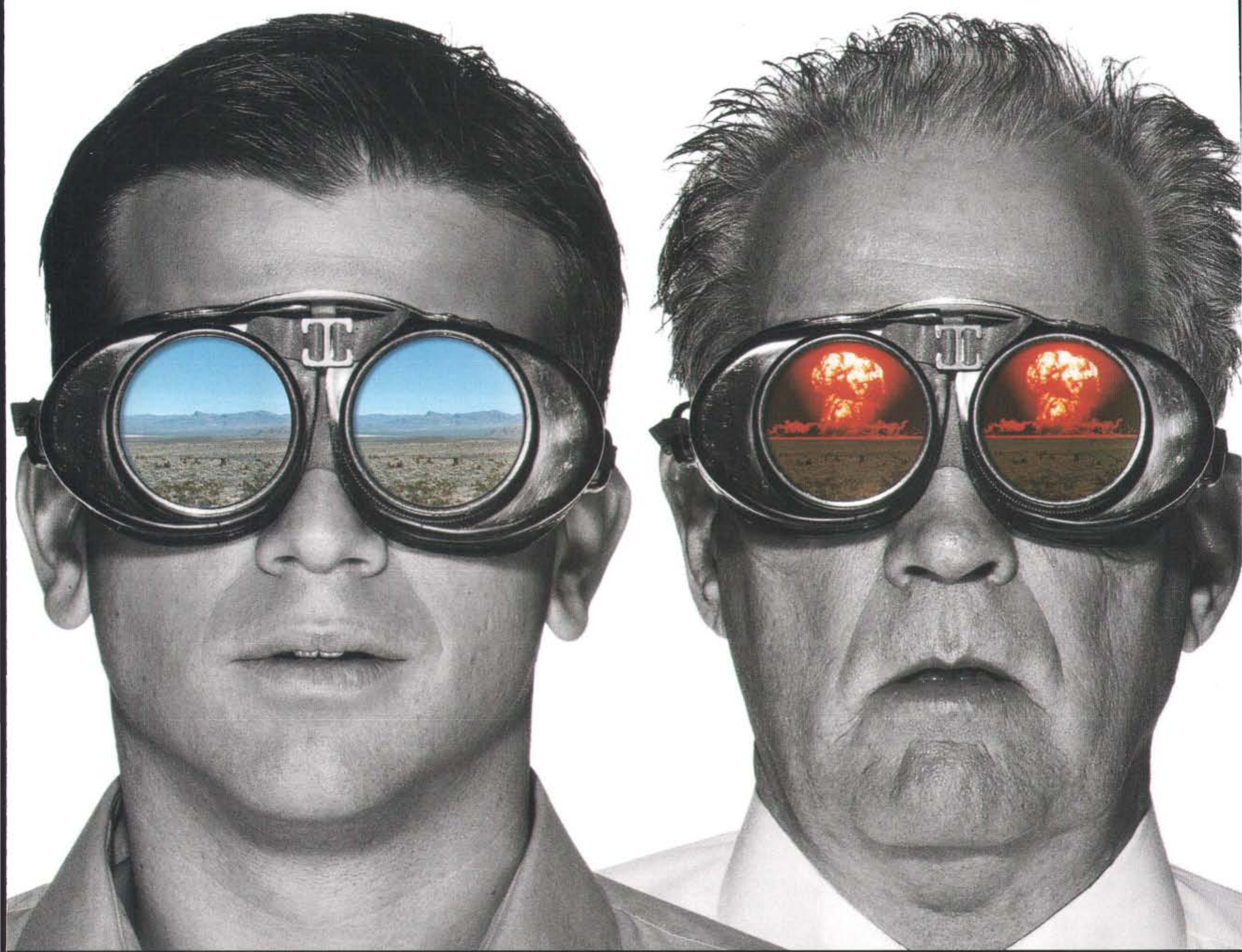

This Is Not a Test

A decade after America's last nuclear test, the US arsenal is decaying and its designers are retiring. Now a new generation of scientists is trying to preserve bomb-building knowledge before it's too late. **By Evan Ratliff**

PHOTOGRAPH: DALE GOLD; STYLIST:ANITA MORAND; GROOMER: MARKUS KEITH; MODELS: MICKEY KELLEY, DAN CASHMAN; INSET LEFT: PETER KURAN/VCE.COM; INSET RIGHT: DEPARTMENT OF ENERGY, NEVADA OPERATIONS OFFICE

This spring, as college students across the country convene study groups and hit the library in preparation for final exams, Charles Nakhleh will be hunkering down in a fenced-off building high on the New Mexico mesa, racing to finish his dissertation. He'll be tweaking the variables in his computational model and checking and rechecking his hypotheses. The thesis will never be published in a scientific journal or even bound with other dissertations and stored on some dusty shelf of a university library. Nakhleh will never be able to make a public presentation or even talk to his family about the details of his work: the W80 cruise missile-based nuclear warhead. To do so, in fact, would be a federal crime. But for Nakhleh, the project marks the final step in his three-year effort to earn the most exclusive diploma on the planet - a degree in thermonuclear weapons.

Nakhleh is one of 11 students in the second graduating class of Titans: the Theoretical Institute for Thermonuclear and Nuclear Studies at Los Alamos National Laboratory. Getting admitted wasn't easy. The program's qualifications include a PhD in physics, chemistry, or engineering; a Q security clearance, which permits access to sensitive national security information; and employment in X Division, the elite Los Alamos nuclear weapons design department. Getting out isn't easy either. To graduate, students spend two years in the classroom studying the physics, hydrodynamics, particle transport, computational modeling, design, and history of nuclear weapons, and one final year in independent study. "The unusual thing about it is that everybody here already has their PhD," says the 35-year-old Nakhleh, who earned a doctorate in physics at Cornell.

That's hardly the most unusual thing about Titans. Consider its mission: to prevent 50 years' worth of nuclear know-how from slipping away.

The loss of knowledge is the result of a post-Cold War era that has changed the nuclear landscape. First came bans on weapons testing. Then the gradual retirement of key there-at-the-creation scientists. Meantime, aging weapons systems were not being replaced. Sure, today's X Division scientists understand the basic materials needed to build any given bomb. But building a nuke is more than following a recipe. They need to master, for instance, the technical tricks required to fit megatons of power into a warhead package. Traditionally, nuclear scientists learned their arcane craft by building and testing generation after generation of atomic devices. In this way, nuclear weapons design is the ultimate applied science.

But what happens when the "applied" part is removed? Los Alamos hasn't set off a nuclear explosion since the US testing moratorium in 1992. Likewise, it's been more than a decade since the US designed or manufactured a new nuclear weapon. Full-scale underground testing has been replaced with massive supercomputer simulations and small-scale experiments, intended not to make new weapons but to "certify" that the weapons in the aging stockpile would still work if detonated and to predict potential failures. Simultaneously, the nuclear scientists with first-hand experience building and testing weapons - those who worked in the nuclear heyday of the '60s - are retiring, taking volumes of unrecorded knowledge with them. The Wen Ho Lee case and the "missing disks" scandal - which hurt lab morale and caused younger scientists to leave - accelerated the brain drain. And those remaining won't be there forever: Within the next five years, half of the designers at Los Alamos will have reached retirement age. By the time the newest US nuclear warhead reaches the end of its intended lifetime in 2014, it is entirely possible that the US will not have a single nuclear weapons designer with test experience.

By 2014, our newest warhead will have reached the end of its intended life, and the US will not have a single designer with test experience.

None of these developments have generated much attention. But suddenly world events are forcing the nuclear labs - and their problems - into the spotlight. The geopolitical landscape is more volatile than at any point since the end of the Cold War. India and Pakistan have raised the number of explicit nuclear powers to seven, with Iraq, Iran, and North Korea all racing to join. Terrorist groups may not be far behind. September 11 proved, quite dramatically, that our Cold War defense posture is out of step with today's security needs. The nuclear abolition movement, after gaining ground throughout the mid-'90s, has been increasingly drowned out by calls for new low-yield nuclear weapon designs to combat terrorist bunkers and provide "flexible deterrence" against the nuclear, biological, and chemical arsenals of the rogue states. The first US Nuclear Posture Review in six years, a classified analysis delivered by the Bush administration to Congress last January, called for both reductions in nuclear forces and, according to Defense Secretary Donald Rumsfeld, "a significant change in US offensive nuclear weapon approach." The review emphasized the need for a flexible arsenal combining nuclear weapons, conventional forces, and missile defense. It also required the labs to shorten the time they would need to return to testing.

Weapons designers, meanwhile, complain that it is awfully difficult to maintain an effective nuclear arsenal in a no-testing world. "Imagine a world in which automobiles aren't being built anymore," says Stephen Lee, the bearded acting deputy division leader of Los Alamos' Computer and Computational Sciences Division. "Two or three people used to build starter motors and still know how they work. A couple of guys know about spark plug wires. But now they're retiring or dying, and the parts are getting older. If you find a cracked spark plug wire, you don't know if it matters. You have to figure out every component individually, and also how the parts all fit together and interact. But you're not allowed to drive the car! You have to maintain it for 40, 60, 80 years and still know how everything works, without ever starting the engine."

Founded six years ago, Titans - along with training programs at the other two national weapons facilities, Sandia National

Laboratories in New Mexico and Lawrence Livermore Laboratory in California – is one part of the Science-Based Stockpile Stewardship Program, an initiative launched by the Clinton administration to address the problems of maintaining an effective nuclear arsenal. Los Alamos, like its sister labs, now reluctantly views stewardship as its primary mission and carries it out on several fronts. There's the attempt to overcome the no-testing handicap with complex computer simulations of explosions. There's an ambitious plan to preserve all of our nuclear knowledge in a digital archive. And there's Titans, the low-budget, low tech program to train the next generation of nuclear scientists.

Nakhleh is preparing for whichever way the nuclear pendulum swings. But one thing he's not prepared to do is simply let the nuclear knowledge just disappear. That, argues Nakhleh, would be "tantamount to dismantling the weapons program, one small piece at a time."

The Cold War created a culture of extreme secrecy. Says one designer: "I have an awful lot of stuff in my head I've never written down."

Historians still debate whether the US stockpile of nuclear weapons – and the doctrine of mutually assured destruction it supports – inevitably followed from the success of the Manhattan Project. There is very little disagreement, however, over another point: Once nukes became a part of our national security system, getting rid of them was enormously difficult. A decade after the fall of the Soviet Union, the role of nuclear weapons, and the labs that created them, has become more entrenched even as it's become increasingly murky.

The United States currently retains roughly 10,000 nuclear warheads. Of those, about 6,000 are strategic megaton class, capable of hitting cities or military facilities anywhere in the world. An additional 1,300 are tactical nukes, smaller warheads designed to be lobbed onto a battlefield. The rest are inactive, meaning in storage.

The Start II treaty, signed in 1993, will reduce the number of strategic weapons to between 3,000 and 3,500 by the end of 2009. This past November, President Bush announced plans to further cut the size of the operational strategic arsenal to as low as 1,700 by 2012 (keeping those weapons in reserve). That decision was part of a deal Bush cut with Moscow in late 2001: US arms reductions in exchange for Russian silence as the US pulled out of the 1972 Antiballistic Missile Treaty. Most arms analysts agree that the administration will stop there, keeping that number of weapons as a "hedge" against a potential Russian resurgence or Chinese buildup.

For the labs, the age of the weapons is more critical than the number. Most of the stockpile had an expected lifetime of 10 years, yet the average age is 18. The youngest warhead, the W88, was introduced in 1991, and several of the key materials used in all nukes – including plutonium pits and tritium fuels – date back to the late 1980s. Although a few have been updated with new components and new nuclear materials (which degrade over time), or have been adapted to alternate delivery systems, the US hasn't manufactured any new weapons since 1992, when the first Bush administration signed a bill halting nuclear design and testing. President Clinton affirmed that position when he signed the Comprehensive Test Ban Treaty in 1996, and though the Senate refused to ratify that treaty in 1999, the US has maintained its no-testing stance.

Despite the aging state of the stockpile, deterrence remains an explicit part of US national security policy. Hence the $5.3 billion Stockpile Stewardship Program, which requires labs to certify that the current arsenal remains operational – and thereby a credible deterrent.

Critics on the right say that the lab directors never fully believed it would be possible to certify weapons without testing. They suggest that the stewardship program is a political convenience. In the mid-'90s, Congress was under pressure to ratify the Comprehensive Test Ban Treaty and wanted some assurance that the aging stockpile would still provide an adequate defense. The national labs, they say, sensed the shifting nuclear climate and used the promise of stewardship as an opportunity to raise billions of dollars in funding.

Arms control advocates, on the other hand, argue that the program isn't really about stewardship at all. "Their aim is not maintaining nuclear weapons, their aim is to design new nuclear weapons," says Greg Mello, who heads the Los Alamos Study Group, a nonprofit watchdog organization based in Santa Fe.

Mello believes that the labs will quickly abandon their stewardship mission if they see an opportunity to develop new weapons, and he's not alone. "They'll go through a development phase," says Robert Nelson, a Princeton University physicist and arms control expert. "Then they'll say 'we really can't certify this weapon if we don't test it.'"

But most security analysts – including those on the arms control side – agree that we must understand the workings of whatever's in our stockpile. "As long as we have nuclear weapons, we need to know about them," says Tom Collina, director of the arms control program at the Union of Concerned Scientists. "If only for the purposes of keeping them safe."

"The Hill," as Los Alamos old-timers call the lab, is an island of blandness in a landscape of striking beauty, a sprawling complex of mundane sand-colored block buildings, spread over 43 square miles of the Pajarito plateau. The lab employs more than 12,000 workers in a variety of scientific, technical, and administrative roles, but the physicists of X Division number 300, and fewer than 50 of those have first-hand design experience. (By comparison, there are 10 times as many NASA astronauts as there are weapons designers in all three labs.)

Their declining numbers and arcane – not to mention all-powerful – specialty gives weapons physicists a certain dark mystique. They roll their eyes at references to a "nuclear priesthood," amused at the connotations of secret rites and religious rituals.

Yet the labs, and Los Alamos in particular, have evolved their own peculiar culture – one with unique language (tests are called "shots"), political memes ("Nuclear deterrence prevents major wars"), and rivalries (a sign once posted at Livermore read REMEMBER: THE SOVIETS ARE THE COMPETITION. LOS ALAMOS IS THE ENEMY). Los Alamos has even hired a cultural anthropologist to help with knowledge preservation.

But it's a culture closed to outsiders. When designers talk about their work, they speak in metaphors. They call on a rehearsed collection of analogies – many of which are recycled verbatim for the streams of journalists who wind their way up to the lab – to describe the task of maintaining the weapons without testing them. An aging nuke, it turns out, is somewhat like a tape recorder, a space shuttle, a desk chair, a baby, a car parked in the sun, a car parked in a driveway, a car parked in a garage, and a car parked in front of a dam.

The scientists inevitably use one of these analogies to make the point that maintaining the "car" under current conditions is an even more difficult scientific problem than simply making a new one. Both the nuclear and nonnuclear components of the weapons transform over time, distorted by age and fluctuating temperatures. Just one small change, like a microscopic crack, could trigger a catastrophic failure, in much the way, the designers explain, that the O-ring failure caused the *Challenger* explosion. In the days of underground nuclear testing, designers had a simple check. Now only certain components can be tested, and the results factored along with small-scale physics experiments into complex computer simulations that attempt to replicate the explosion of a nuke. The simulation team expects to have a full 3-D sim completed by 2004.

While the simulation team tackles the problem of maintaining weapons, Stephen Lee is focused on the problem of knowledge loss. His mission: to create a digital archive for the volumes of data at Los Alamos. This is no small task, considering that the current collection consists of half a petabyte of information, including 8 million paper records dispersed in various buildings, hundreds of videotaped interviews with designers, 19 unconnected electronic databases, and a constant stream of new data generated by small-scale experiments.

Lee has proposed a searchable archive that links scanned copies of all paper records, digitized videos, and images of objects or places recorded by webcams. Search algorithms would make connections between related bits of information. The records themselves would stay distributed, and need-to-know security walls would determine who could get to what. But Lee's project, set to get under way last year, was put on hold, a victim of budget cuts.

Scattered digitizing efforts continue, and Lee hopes to have his funding restored this year. But even if the money is secured, archiving faces a perpetual challenge: Los Alamos culture. "There are certain weird things that evolved in the culture that we exist in because of security," says 18-year X Division veteran Jas Mercer-Smith. Namely, a disincentive to write or keep technical papers that then would become the author's responsibility to keep secret. In the Cold War rush to build new generations of weapons, even less-secret information often went unrecorded. If a weapon tested successfully, the scientists turned their attention to the project, rarely taking the time to document the physics. "I have an awful lot of stuff in my head that I've never bothered to write down," says Mercer-Smith, who oversaw half a dozen nuclear tests. "Part of that is just laziness," he admits. "Part of it was that it was always more fun to move on to the next thing."

> **Low-yield nukes trouble old-timers, who designed weapons never to be used. "Nuclear weapons are supposed to be scary and big and horrible."**

Even if he had found the time, much of the "stuff" in Mercer-Smith's head likely couldn't have been written down, at least in any usable form. Nuclear design know-how is what Donald MacKenzie, a professor of sociology at Edinburgh University, calls tacit knowledge – information that "has not been, and perhaps cannot be, formulated completely explicitly and therefore cannot effectively be stored or transferred entirely by impersonal means." Although you may know how to ride a bicycle, for example, you would have a hard time writing down exactly how to do it – which is why people learn through a combination of practice and verbal advice from someone with more experience.

At Los Alamos, vast amounts of knowledge were passed from older designers to younger ones through individual mentoring. "It's a storytelling culture," says Lee. "One person knows something and tells it to somebody else."

Which explains why Titans is not viewed as a low tech fix to be abandoned as soon as a digital archive is completed, but more grandly as an attempt to formalize the lab's mentoring tradition. The two years of classroom instruction include lectures by current and retired designers and field trips to other nuclear facilities. "One of the major benefits, especially the lecture portion, is that it provides an easily accessible forum for digesting a large amount of information efficiently," says Nakhleh, the third-year Titans student, "rather than finding out each of these bits one by one from someone in the hallway."

With the lab relying so heavily on supercomputer simulations to evaluate the effects of aging, Titans emphasizes both the use of computational tools and the importance of human analysis to synthesize the results. The goal is for younger designers to develop the ability to interpret the data spit out of simulations with the same discrimination that the graybeards applied to real tests. Some people question whether that can be achieved. "The hardest thing is judgment," says Merri Wood-Schultz, a senior designer who teaches explosion modeling for Titans. "That's where we miss testing the most."

But without testing, Titans may be the only way to teach the subtle human element of weapons design. "You can record the distance to the moon, and the gravity of the moon, and things like that," says Titans' cofounder, Michael Bernardin. "But it's something else to determine how you get to the moon. You need the data, but then there's the thinking portion that gets you there."

While Nakhleh and his fellow students learn the inner workings of our nuclear weapons, and the designers of the X Division work to maintain the stockpile, some in Washington are studying whether our current arsenal even makes sense post-September 11. That morning, several thousand thermonuclear weapons were at the ready, positioned on bombers, submarines, and intercontinental ballistic missiles tipped with multiple warheads. "We have 10,000 nukes of every kind imaginable in our arsenal, including a few thousand that can be launched on hair trigger," says Bruce Blair, president of the Center for Defense Information, a policy think tank. "And that had absolutely no effect on protecting the United States."

In the days after the attacks, the Bush administration refused to rule out the possibility of nuclear retaliation. But few people took such a suggestion seriously, and for good reason. The same qualities that made the arsenal ideal for deterring a Soviet attack - massive numbers of devastatingly powerful weapons, positioned to withstand a broad nuclear onslaught and still guarantee the ability to obliterate a nation - make it a weak deterrent to scattered networks of terrorists happy and willing to die.

Even before September 11, the small cadre of Bush defense advisers preparing the Nuclear Posture Review was reevaluating the role of nuclear weapons and thinking about building new ones. "We are in a completely new debate," says Blair. "We're looking at all of the options, from new weapons to first strike: missile defense, homeland defense, civil defense. It's the thinking of the 1950s, when we saw the Soviet Union as a rogue state. We've kind of gone full circle."

In fact, the 1994 US Nuclear Posture Review still requires the Department of Energy, which oversees the labs, to "maintain the capability to design, fabricate, and certify new warheads." Now, with the specter of nuclear-armed rogue nations and terrorists looming, the temptation to call on those design skills grows daily. A chorus of analysts is arguing to replace the high-kiloton, multiwarhead missiles in the current arsenal with a new generation of low-yield, single-warhead weapons (specifically ground-penetrating bunker busters). Both Stephen Younger, the former director of the weapons program at Los Alamos, and C. Paul Robinson, the current director of Sandia, are advocating new weapons. "I believe that we would desire primarily low-yield weapons with highly accurate delivery systems," Robinson wrote last spring, "for deterrence in the non-Russian world."

And policy planners are listening. The National Institute for Public Policy, an outfit with close links to the Defense Department, released a study last year concluding, in part, that "to ensure that enemy facilities or forces are knocked out and cannot be reconstituted, attacks with nuclear weapons may be necessary. In the future, the United States may need to field simple, low-yield, precision-guided nuclear weapons for possible use against select hardened targets such as underground biological weapons facilities." Last summer, senators John Warner (R-Virginia) and Wayne Allard (R-Colorado) attempted to overturn a 1994 congressional ban on the development of nukes smaller than 5 kilotons. The provision was dropped, but they did mandate a DOE study on the feasibility of low-yield nukes.

September's attacks redefined the debate, analysts insist: "We're looking at all of the options, from new weapons to first strike."

Low-yield devices, however, with their possible use as first-strike weapons, create a surprisingly sticky issue for the weaponeers. Although Los Alamos culture is often criticized as one in which morals are separated from science, the reality is that nuclear weapons science simply comes with a particular set of hard-and- fast morals.

"Making low-yield weapons is not a hard problem," jokes Mercer-Smith. "We call them failures." Speaking more seriously, he explains why most designers support the ban on low-yield nukes - they see it as their job to make weapons so terrible they will never be used. Building smaller nuclear weapons contravenes the moral calculus that has been part of the lab culture for decades. "Nuclear weapons are supposed to be scary and big and horrible," he says. "Blurring the distinction is not a good idea."

John Pike, a defense analyst and director of GlobalSecurity.org, agrees: "For the last half century we have done everything in our power to tell people that nuclear weapons are different," he says. "The existence of nuclear weapons places an upper limit on the level of violence that is conceivable in a war - and that is why countries have them. The notion that we would break that taboo, and tell people that nuclear weapons are just like dynamite, is inconceivable."

The recent review put off a final decision on developing new weapons, but whatever the administration decides, the labs will adapt, just as they adjusted to a post-testing world when their survival depended on it. After all, low-yield nukes would undoubtedly be a boon for the future of the nuclear complex, and perhaps even permit a return to testing. "This new trend of expanding the roles and missions of nuclear weapons to deal with undeterrable rogue threats," says Blair, "is the salvation of the laboratories."

Eventually, Charles Nakhleh and other Titans graduates could end up completing the task they were trained for but never expected to carry out - designing and testing nuclear weapons.

Nakhleh himself is sanguine about the future of the arsenal, content to use his training to tend the stockpile if that's what the policy dictates. But when pressed, he allows that the pinnacle of nuclear weapons science, like any other scientific endeavor, is in making some important discovery and advancing the field.

"I make an analogy with peacetime military and wartime military," he says. "Can you think of a famous peacetime general? I can't." ■ ■ ■

Contributing editor Evan Ratliff (evan @wiredmag.com) *wrote about Russian rockets in* Wired *9.12.*

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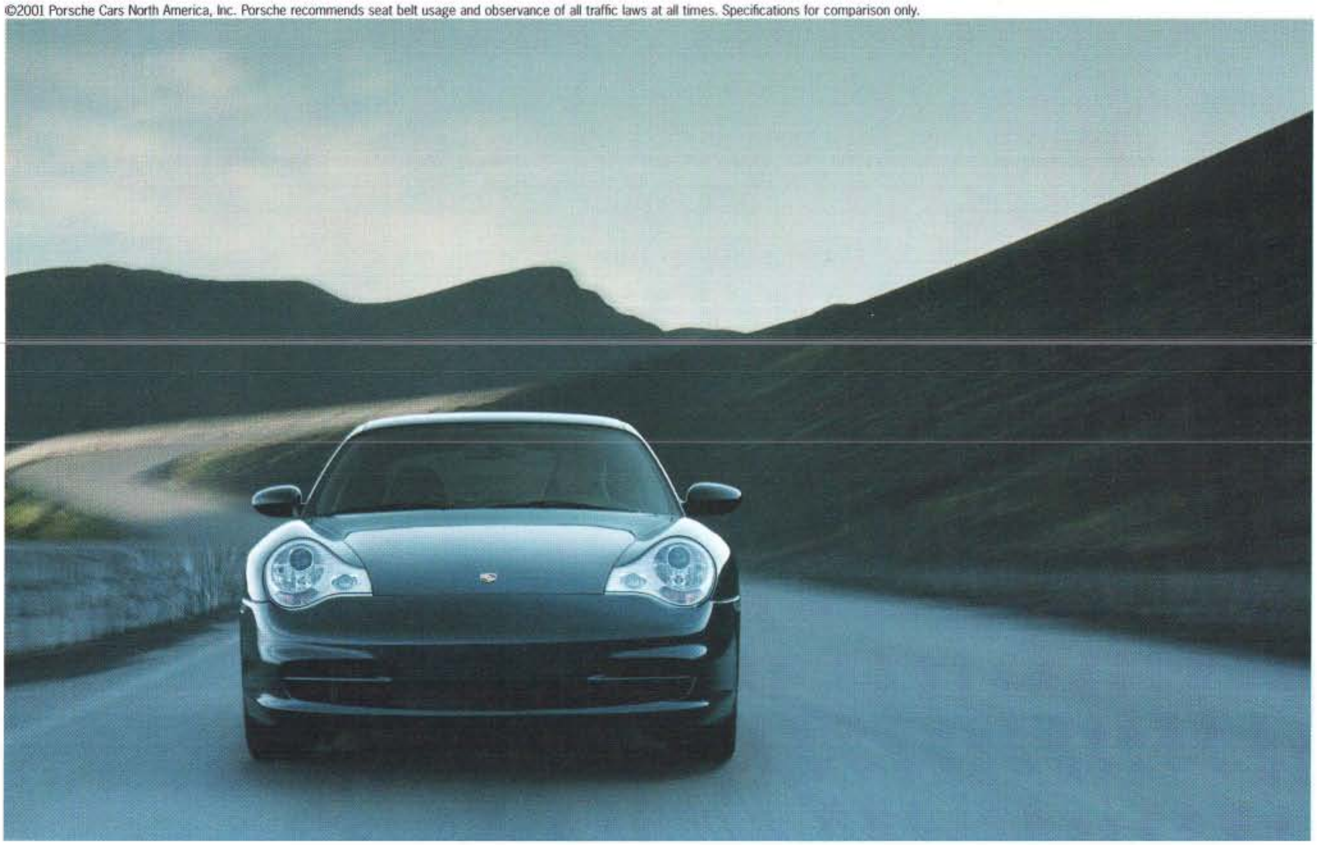

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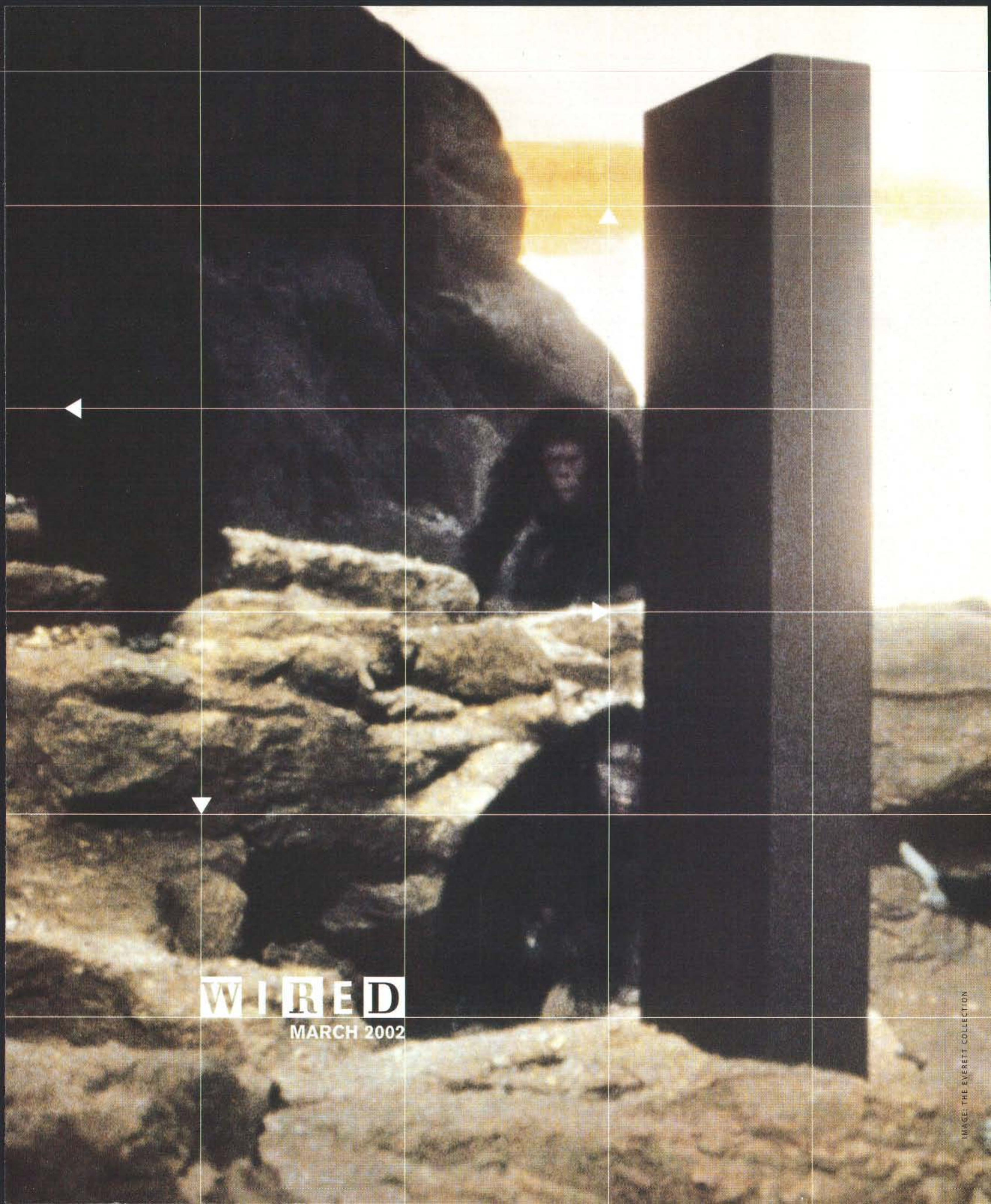
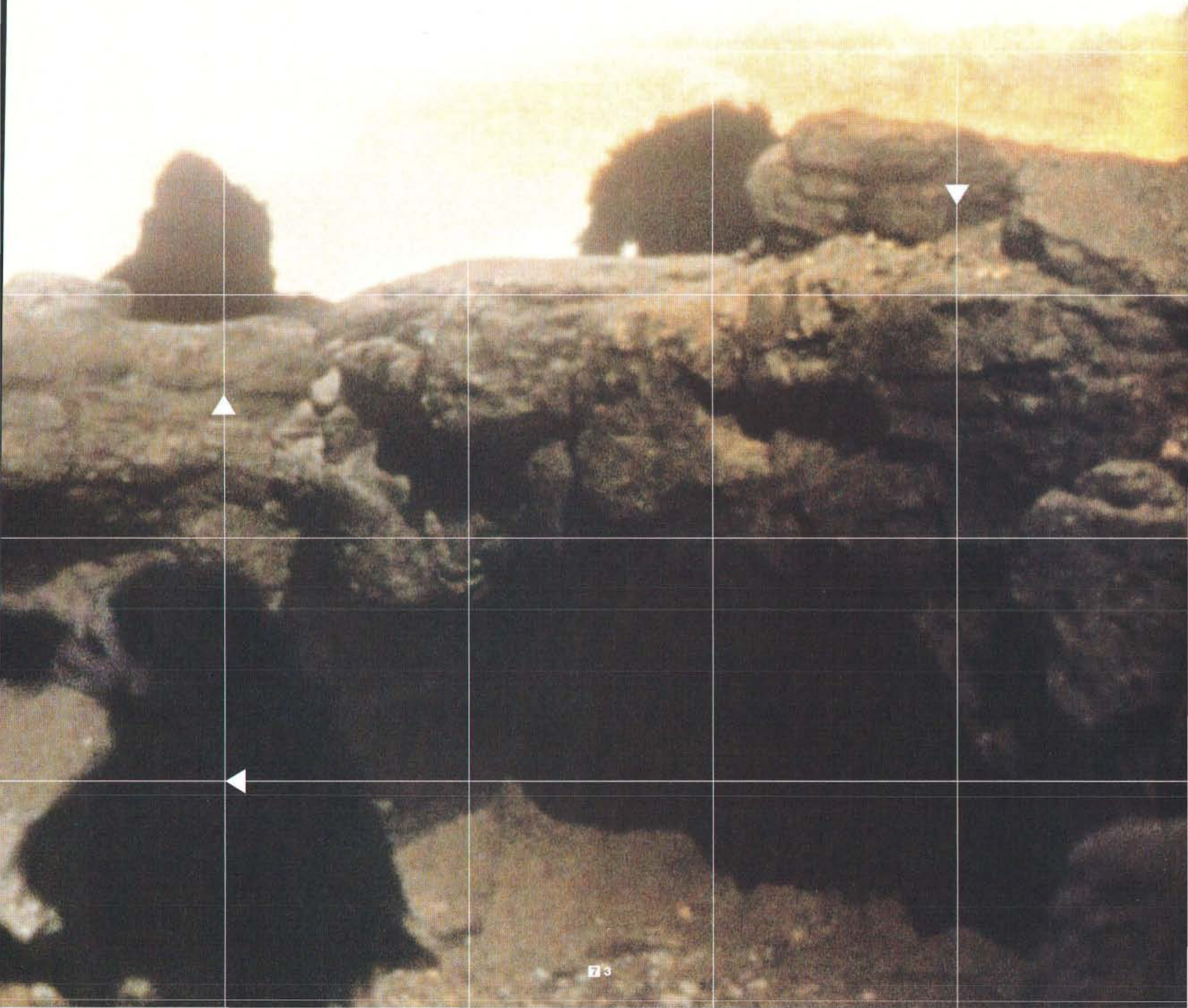


IMAGE: THE EVERETT COLLECTION

> **Today's artificial intelligences are devoting themselves to the very same problems – hunting, pathfinding, trying to satisfy their basic desires – that our ancestors wrestled with at the dawn of man.** – Steven Johnson, "Wild Things"



It's Alive!

From airport tarmacs to online job banks to medical labs, artificial intelligence is everywhere.

By Jennifer Kahn

In the 1960s, cyberneticians predicted that machines would be smarter than people within 20 years. Artificially intelligent computers would be building cities on Mars and solving diplomatic crises at home. (Along the way, of course, we'd have created a nice set of steel-plated servants: robot butlers to greet our guests, robot nannies to watch the kids.) But somewhere between promise and production, the fantasy got derailed. AI came to mean a computer that could beat the pants off most chess players, but not one that could vacuum the living room or understand why it's a bad idea to spread toothpaste on toast. "Intelligence," we discovered belatedly, leaned heavily on the shared experience of being alive and sentient in a physical world.

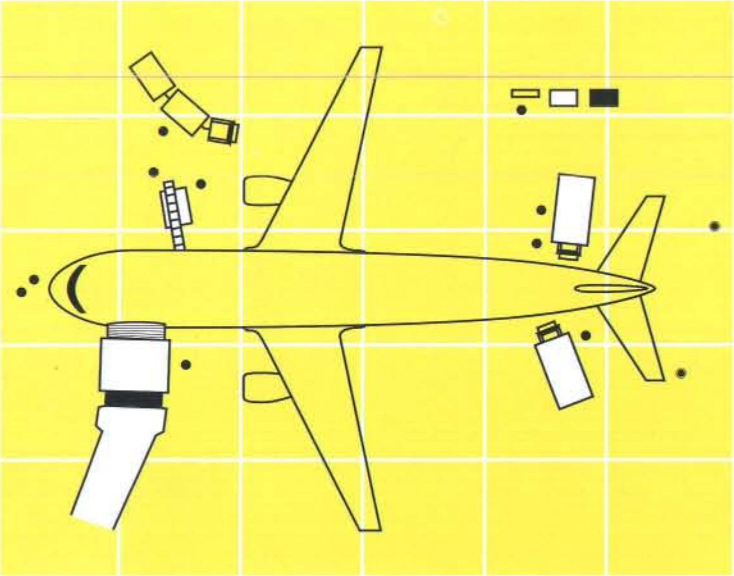
The accumulated weight of broken promises pushed the field into a deep freeze: the so-called AI winter. Years passed unmarked by breakthroughs. The Soviet Union disintegrated. The stock market rose, and fell, and rose again. Somebody cloned a sheep. And still no robot maids.

Quietly, though, AI researchers were making more than progress – they were making products. It's a trend that's been easy to miss, because once the technology is in use, nobody thinks of it as AI anymore. "Every time we figure out a piece of it, it stops being magical; we say, 'Oh, that's just a computation,'" laments Rodney Brooks, the director of MIT's Artificial Intelligence Laboratory. "We used to joke that AI means 'almost implemented.'"

In truth, we may never chat up a computer at a cocktail party. But in smaller yet significant ways, artificial intelligence is already here: in the cruise control of cars, the servers that route our email, and the personalized ads clogging our browser windows. The future is all around us.

1

Adaptive Learning



FLY THE BRAINY SKIES

Lately, software has become as upwardly mobile as people, advancing from the clerical pool into management, a field formerly dominated by humans. Take airports. It used to be you needed a dozen people armed with grease pencils and flight schedules to assign gates, direct baggage, and decide which ground-crew employee should refuel which plane. Instead, there's SmartAirport Operations Center, a logistics program created by Ascent Technology.

Computationally, airports may present the world's most challenging resource-allocation problem. Planes arrive late, snow starts to fall, employees go home sick – and each change dominoes into another. Ascent's software is the octopus that jiggers all the details until they fit, scheduling flights to get planes back in time for maintenance checks and assigning jobs while factoring in the workers' qualifications, upcoming shifts, and current locations. Since September 11, the system also keeps track of which incoming jets need an FAA-mandated security sweep.

It's logistics, but the problem is more subtle than a giant equation. There's no way to "solve" an airport and include all the thousands of variables. Instead, genetic algorithms use natural selection, mutating and crossbreeding a pool of suboptimal scenarios. Better solutions live, and worse ones die – allowing the program to discover the best option without trying every possible combination along the way. In daily life, people do this instinctively. When there's traffic on one road, we take another, factoring in our knowledge of stop signs, route lengths, and speed limits. But a commuter can handle only so many variables before getting overwhelmed. For a problem as complicated as an airport, Ascent beats humans hands-down, raising productivity by up to 30 percent at every airport where it's been implemented. "Figuring out ways to optimize a complicated situation is what genetic algorithms do," says Ascent founder Patrick Winston, whose firm's first contract was handling the logistics for Desert Storm. "Like maybe there are some gates or jobs that could be swapped to make things easier for everybody." That means untangled terminals at SFO, Logan, Heathrow, and many others.

2 Text Parsing

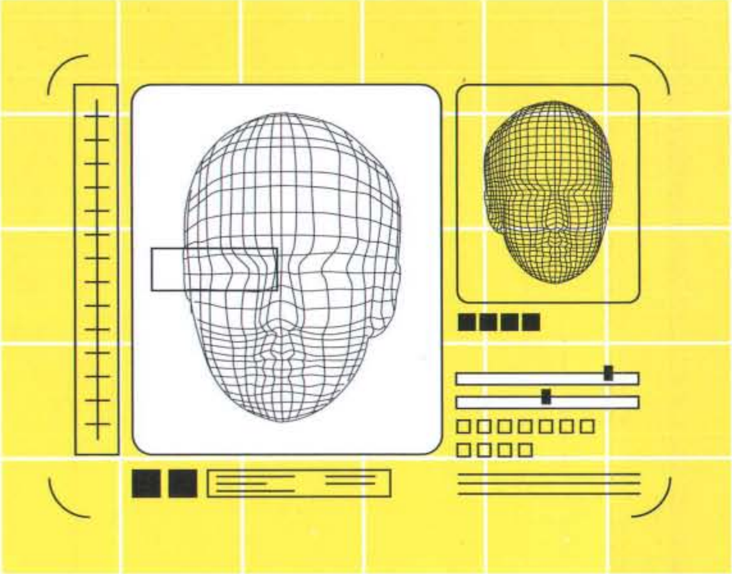
WANTED: entry-level account manager. Job involves
occasional travel to New York. Send resume to...

GET A JOB

Finding the one relevant detail in a sea of information may be the human brain's most useful talent. And it's a tricky skill to replicate. To do it well, computers must be able to understand some subtleties about what you're looking for. While all-purpose search engines like Ask Jeeves are still struggling with this chore, other sites are benefiting from smarter applications. The vast job bank Monster.com, for instance, uses an intelligent Web crawler called FlipDog to find new customers. Wandering the Web, the crawler develops a sense for which parts of sites are more likely to contain jobs, then parses the pages to pull out the relevant information (company, salary, kind of work, address for sending a résumé) and files it in a database. The first time the crawler ran, it came back with more than half a million jobs. The real feat was not that FlipDog found the postings, but that it was able to organize them. "'Send your application to New York' is different from 'you'll be traveling to New York,'" notes Tom Mitchell, the Carnegie Mellon professor who developed the application for Utah startup WhizBang! Labs. "The system had to learn to recognize those kinds of differences on its own."

Rather than rely on dictionaries, FlipDog focuses on word position ("send" close to "résumé" close to a city name) and format clues (like bold type). For documents with relatively consistent features, such as job postings, this approach works better than ones that try to infer meaning by brute-force grammatical analysis. Another advantage is that the system transcends the language barrier almost effortlessly. With just minor tweaks, FlipDog works as well on Japanese sites as on English ones.

3 Pattern Recognition



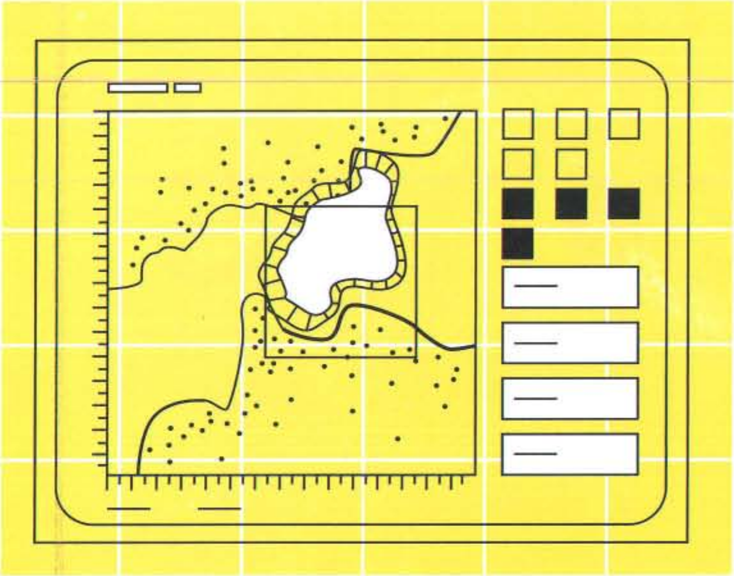
STOP THE SCAM

People notice the patterns in things. As good as we are, though, artificially intelligent software is even better – at least at spotting patterns that could indicate an insurance scam or credit card fraud. The difference is a matter of processing. Human fraud watchers gravitate toward the obviously suspicious: sudden large purchases of jewelry, for instance. The Falcon program, designed by San Diego-based HNC, works at a deeper level, maintaining a perpetually microadjusting profile of how, when, and where customers use their credit cards. "Good behavior is more predictable than fraudulent behavior," explains cofounder Todd Gutschow. By studying your habits, Falcon develops a keen eye for deviant behavior, which it detects using a combination of neural networks and straight statistical analysis.

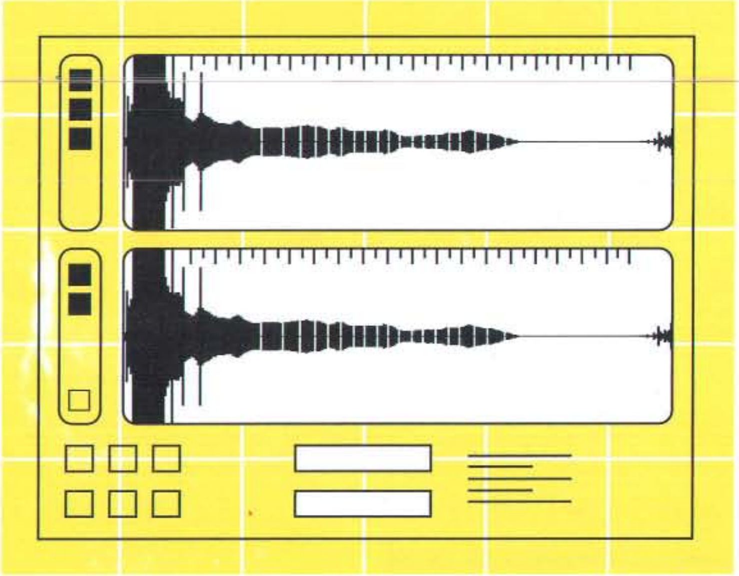
Neural networks work roughly like the brain: As information comes in, connections among processing nodes are either strengthened (if the new evidence is consistent) or weakened (if the link seems false). Because patterns emerge impressionistically – from a combination of weighted correlations, rather than from a few red flags – programmers can't always pinpoint what the software deems suspicious. That technique has served HNC well: Falcon is used by 9 of the top 10 US credit card companies; they claim it has improved fraud detection rates from 30 to 70 percent. Meanwhile, the company has created spin-off applications. There are now programs that spot fraudulent workers' comp claims and others that help dun deadbeats for collection agencies.

Jennifer Kahn (kahnjenn@hotmail.com) *wrote about the Human Brain Project in* Wired *9.08.*

4 Expert Systems



5 Speech Processing



MAKE A DIAGNOSIS

Intuition may seem like a human trick, but machines can be pretty good at it, too. Underlying a hunch are dozens of tiny, subconscious rules – truths we've learned from experience. Add them up and you get instinct: a doctor's sense that a patient's stomachache might really be appendicitis, for example. Program those rules into a computer and you get an expert system – one of many that can screen lab tests, diagnose blood infections, and identify tumors on a mammogram. Lab technicians haven't vanished, but they've been joined by machines like FocalPoint, which examines Pap smears for signs of cervical cancer. Built by TriPath Imaging, FocalPoint screens 5 million slides each year, or about 10 percent of all slides taken in the US.

To construct FocalPoint, programmers quizzed pathologists to figure out the criteria they consider when identifying an aberrant cell. Nuclei that look darker or larger than others, for instance, often have too many chromosomes inside. Like human lab techs in training, FocalPoint teaches itself by practicing on slides that pathologists have already diagnosed. But unlike a real person, the system can't be changed once it leaves TriPath's lab. "We have to guarantee our accuracy," explains Bob Schmidt, the technical product manager for TriPath. "If FocalPoint kept learning 'in the wild,' its performance would vary depending on the skill of the lab tech who was teaching it." Which is to say, a lousy technician could undermine an already smart program. "That's the advantage of an expert system. It allows you to replicate your very best people."

TALK TO A MACHINE

Running airports, reading Pap smears – it's all well and good, but the original point of AI was simpler. We wanted machines that could understand us. What we got was a generation of computers able to field phone calls about travel schedules and tax audits, but nothing that you could really talk to. In December, Handspring took it to the next level: Its after-hours tech support program verges on conversational.

"The systems used by airlines work when you have one or two questions that people might ask," explains Ashok Kholsa, who developed the speech-processing system. "But when the number of possible queries is as big as it is in tech support, you can't just step through a logic tree." Call up Handspring, explain your problem any old way, and the system will dutifully extract essential words like "PDA," "screen," and "error message." Using statistical analysis, the program identifies phonemes, or letter sounds, within a spoken sentence and assembles them into a variety of possible words. "Noise" words get discarded, keywords kept. Based on the combination of keywords, the computer might suggest a fix – or probe for more information, a strategy the flesh-and-blood technicians call "disambiguation."

Whether the system creates less or more aggravation is still to be determined. "Right now we're trying to see how long people last before they bail out," says John Stanton, director of customer relations for Handspring. When consulting a computer on how to fix a computer, you can start to feel like the middleman. ■ ■ ■

Wild Things

They fight. They flock. They have free will. Get ready for game bots with a mind of their own.

By Steven Johnson

It is the year 2002. After an explosion of R&D funded by software giants and startups, more than a third of US households are populated by sophisticated artificial intelligence bots – their decisionmaking guided by complex neural nets and simulated emotions, their perceptual systems honed to detect subtle changes in their environment. Every day millions of Americans interact with these creatures, encountering advanced technology from nuanced natural language routines to gesture recognition to machine learning. Perhaps most impressive: As the AIs have grown smarter, they have begun to communicate among themselves, sharing new ideas and collaborating on group tasks.

This is not some hopelessly optimistic sci-fi scenario from 20 years ago. It is reality. Consumer-grade artificial intelligence is alive and well in the world of games.

If you've played a videogame released in the past year, you probably know the feeling: the eerie, ghost-in-the-machine sense of interacting with a semi-intelligent creature existing somewhere on the other side of the screen. It's what happens when a lone sentry in *Metal Gear Solid 2* tracks your bloody footprints straight to your hiding place, calls in reinforcements, and then launches a sophisticated group assault on your position. It's when your fellow marines seamlessly coordinate a flanking maneuver around an alien squad, while navigating the rocky, uneven terrain of *Halo*. Or when a small riot suddenly breaks out in *Grand Theft Auto III* after your carjacked SUV crashes into a pedestrian. It's a world of spontaneous, adaptive, sometimes even smarter-than-you behavior, a million light-years from the one-dimensional assault of *Space Invaders*.

You can measure the flowering of game AI in a number of ways. Start with CPU cycles: All game development is a struggle over this most precious of resources. Historically, games made graphics a priority over everything else, often leaving AI routines for the spare cycles. But most complex games today devote extensive processor time to AI code: One recent poll of developers showed a sevenfold increase in CPU time used for AI in the average game since 1997. Hardware advances are accelerating this trend. Today's game machines and game-ready computers have two processors, nearly equal in power: The 3-D chip handles the graphics, and the CPU is increasingly devoted to artificial intelligence. It's no surprise that there are at least six AI PhDs now working in the game industry, and that MIT's Marvin Minsky, the elder statesman of modern artificial intelligence, lectures at game developer conferences. Almost all games now include an AI designer credit, and some AI wizards – like *Black & White*'s Richard Evans – have become minor celebrities among hardcore gamers.

The newfound stature of game AI is readily visible to ordinary players. *The Sims* features a button on its preferences screen that lets you toggle "free will" on and off. Turn it off, and the characters become hapless puppets, relying on your instructions at every turn. Turn it on, and the Sims

Munch's Oddysee: Munch (right) and Abe work as a team: Toggle from one and the Alive 2 AI engine will take over the other.

IMAGE: COURTESY MICROSOFT

> "My ape couldn't find someone to heal. He got pretty upset. **So he threw a guy against a mountain.** Then he healed him. After that he looked at me all happy and smiling."

take on a life of their own: dancing, swimming, shooting pool, showering – all dictated by their ever-changing moods.

It's tempting to trot out that old standby of AI research and ask whether today's games have passed some kind of Nintendo-era version of the Turing test, but in a way, the question is too easy. (The computer-controlled bots in a first-person shooter like *Unreal Tournament* can easily pass for human opponents.) What's more striking about the latest generation is the appearance of unscripted, emergent behavior – the AI stumbling on new ways of responding to the world, strategies and behaviors that weren't deliberately planned by the designers. You can see this most clearly in Peter Molyneux's landmark *Black & White*. A kind of artificial pet, your creature in *B&W* can take the form of about a dozen mythological animals and can be trained to interact with the objects and inhabitants of the game world through a simple feedback system. Tear up some forests or shower rain on a local village, and your pet will start to mimic your actions. If you like his mimicry, you reward him by petting him gently; if he's bad – setting fire to villages instead of watering them, say – you can give him a quick slap across the face. Over time, the creature learns, based on your tutelage.

Fans of the game have created sites to share anecdotes about the bizarre or uncanny deeds they've coaxed out of their creatures. Consider this post from The Creature Stories Archive:

"My creature is still pretty young – age 8, and I'm only in level 2 up to now. Anyways, while I was in level 1 I got the healing spell. So I thought, it would be pretty neat to teach my little ape this spell. Since Adiz wants to be always kind and generous to the people, he ran to the village to try his new spell. He looked around and I guess there was no one to heal. He got pretty upset about that. So he just picked up a guy and threw him as hard as he could against a mountain. The man rolled down, and – for some reason – survived. He was hurt pretty bad though, screamed like hell, and was trying to get back to his house as quick as possible. My ape of course saw that, and healed him. After that he looked at me all happy and smiling."

There are hundreds of these stories, lined up one after another, recounting behavior that may well be unique to each creature. Blur your eyes as you scan them, and you might think you were looking at a parenting site, rife with excited accounts of junior's latest breakthrough.

Five years ago, when games like *Myst* began to be taken seriously as cultural forms – not unlike the period in the mid-'60s when the highbrow music critics started reviewing rock albums – one persistent gripe revolved around their lack of psychological depth. (Think of the horrific faux-British accents of *Myst*'s "actors" or the character-less drones of *Doom*.) Those early critics had a point, but they were using the wrong criteria: That generation of games was interesting largely for architectural reasons – they had environments to explore, not relationships to develop. The art of playing them was the art of movement, not psychology. Much has changed in the half decade since: While the worlds conjured up by today's games are even more vividly realized than before, the biggest shift has been psychological. Consider the mental toolbox of a computer-controlled character (also called an NPC, for "non-player character") in Microsoft's flagship Xbox game, *Halo*. NPCs in *Halo* have real-time perceptions about the world around them (aural, visual, and tactile); knowledge

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Halo: The computer-driven bots could easily pass for human-controlled opponents.

Black & White: Over time creatures develop distinct personalities, based on your training.

about the "state of the world" as they've perceived it (memories of enemy sightings, weapon locations); an emotion system that changes based on events (growing more fearful during enemy onslaughts); and a decision-making system that consults the other three systems to decide whether to attack, run for cover, or initiate another behavior.

The specialized modules of *Halo*'s artificial brains mirror what we now understand about the human mind's architecture. Instead of a single general intelligence, the brain is more like a Swiss army knife of task-specific tools – face recognizers, syntax decoders, memory subsystems – that collectively create our varied and adaptable intelligence. As game AI has moved from crude if-then decision trees to the parallel, distributed intelligence of today's computer-controlled characters, it has become a kind of testing ground for the modular theory of the mind. At a recent game developer conference, MIT's Bruce Blumberg demonstrated an even more advanced simulation of a modular mind: a virtual dog called Duncan, whose mental routines included an advanced memory and object recognition system that enabled it to make commonsense predictions about the world around it.

The artificial minds of today's games have also become better at collaborating with one another. One recent trend in game design – facilitated by state-of-the-art collaborative AI – is flocklike behavior, where dozens of NPCs will follow the player around an environment, dutifully helping out with tasks where appropriate. This can be visually stunning, much like the elaborate group choreography of an ant colony. In the flagship GameCube title *Pikmin*, designed by Mario creator Shigeru Miyamoto, your onscreen character leads a herd of all-too-cute creatures (called Pikmin) across a trippy garden-floor landscape. The effect is immediately startling: The Pikmin trail behind you like a band of arthropod groupies. But that kind of behavior can be fiendishly difficult to model. After all, getting single characters to traverse a landscape in a convincing fashion – without getting trapped in a corner or moving through walls – is a taxing enough problem. (It's no accident that the first generation of game AI was largely devoted to pathfinding routines.) Trying to usher a band of 30 characters through a doorway without creating an artificial-looking assembly line is significantly harder.

In *Munch's Oddysee*, the latest installment in the *Oddworld* series, up to several dozen NPCs can accompany the primary character. *Oddworld* lead designer Lorne Lanning considers the success of those group interactions to be one of the most essential AI achievements of the title. "These seem like really mundane tasks," he says, "but it's more like navigating a big class of preschool kids." Those navigations are coordinated by the game's new Alive 2 engine, short for Aware Lifeforms In Virtual Entertainment. During a complicated attack sequence, the *Oddworld* bots have an uncanny knack for protecting the main player, while negotiating dozens of simultaneous challenges presented by the environment: "They're running all these different series of checks, while still maintaining the sense of life," Lanning explains. "They're thinking: 'Wait a minute, I can't go into the water; also, there's an invisible barrier over here that I'm not supposed to get past because it will get my collision code into trouble; and I've got to keep track of the distance I'm trying to keep from all the other characters. And at the same time, I'm trying to avoid enemies and protect the main character.'"

The computer-controlled marines that accompany you as you explore *Halo* have a complex and fluid communication system that enables them to adopt dynamic military strategies on the fly. Playing, you'll sometimes find yourself ushering the marines into a particular formation; on other occasions, you'll find yourself following their lead. That parity exists behind the scenes, too. "One of the things that makes *Halo*'s AI interesting is the

IMAGES FROM LEFT: COURTESY MICROSOFT; COURTESY ELECTRONIC ARTS

The Sims: A "happiness landscape" leads characters to the objects of their desires.

sense that the AI doesn't cheat. It doesn't regard you, the player, as anything special, nor does it know special things about where you are," explains *Halo* AI engineer Chris Butcher. "The NPCs all have their own unique knowledge model, which means that any given character in the world doesn't know where the player is. All they know is where they last saw him."

The limitations of the NPC perspective are a measure of how advanced today's AI truly is. In the old days, you had to make your virtual characters omniscient to make them believable; today's bots can learn about the world on their own, usually employing a neural net system that strengthens or weakens associations between objects or other players based on their experience in the game. The creatures in *Black & White*, for instance, use the binary feedback from the player to develop an ever-more refined behavioral model. If you punish your creature after he devours a villager, you may find him refraining from eating altogether for a while, because he will have established a connection between your negative feedback and the act of eating. But if you reward him after he dines on some harvested grain, he'll start to recognize that eating the villager is what got him into trouble the last time, not the act of eating itself. With a slap or a cuddle from the player, the creature's relationship to the world grows more nuanced, and more distinctly his own.

Virtual organisms aren't the only ones doing the thinking. Today's game AI also revolves around *objects* that think – sometimes called smart environments. Ironically, the virtual people in the most influential AI implementation to date – *The Sims* – aren't very smart at all. Their intelligence derives as much from the world around them as from their own innate cleverness. Items in the game (refrigerators, pool tables, chairs) effectively contain their own "instructions for use." The Sims themselves are like little wondering processors executing programs embedded in the objects around them. The question that Will Wright and his team grappled with early in the design process was how to create a convincing system for satisfying desires. In a house full of potential activities, how does a Sim decide to do one thing over another? Wright calls the solution they came up with a "happiness landscape," borrowing from evolutionary theory's concept of a "fitness landscape," in which organisms climb ever-higher peaks of adaptive fitness as natural selection runs its course.

"Rather than traversing a genetic landscape of fitness," Wright explains, "you're traversing a spatial landscape of happiness. We had a little cheat that you could turn on: You could graph the happiness values, and when a character assumes a given spot, it starts climbing gradients of happiness. So if I'm hungry, the happiness landscape changes, and things that are providing food will have a higher peak in that landscape. And if I happen to be on the slope of a fridge, I'll start climbing that slope until I get to the fridge. After I eat, all of a sudden the peak will collapse." The graph dramatizes how the Sims' movements are guided by the intersection of their desires and the objects that cross their paths. The slope of the bed extends all the way across the house, while the pinball machine extends only a few feet. A fatigued character will start climbing the slope toward the bed no matter where she is; if she needs some entertainment, she'll migrate to the pinball machine but only if it's nearby.

"The biggest problem we had was formally describing happiness for it to work," Wright says. "I literally went around my house looking at all the crap and tried to figure it out: What was the justification I had for buying this thing? What did I think it was going to help me do? So we had to come up with the smallest number of needs that we could use to justify the largest number of objects."

IMAGE: COURTESY ELECTRONIC ARTS

In what other creative field does an artist borrow from **consumer psychology, evolutionary theory, and software pathfinding** – not to mention home decorating?

The happiness landscape may be the ultimate example of why game AI is such a fascinating space right now. In what other creative field do you find an artist borrowing from consumer psychology, evolutionary theory, and software pathfinding models – not to mention home decorating – all to create a title that sells millions of copies and is almost demonically fun to play?

The intellectual energy associated with game AI has tightened the connection between the academic AI community and the game developers. That connection will grow stronger in the coming years, according to John Laird, who's served as a liaison between the two worlds. In early 2000, Laird, a professor of computer science at the University of Michigan, coauthored a manifesto of sorts for the research AI community, arguing that games provide a perfect environment for experiments in human-level AI – and offer a better career path than creating smart software for more traditional clients like the Department of Defense. "What we're now seeing is a generation of grad students who grew up playing videogames," Laird says. "In the next five years or so, we're going to see a lot more people going to grad school wanting to focus on AI and games, and then going into the industry. It's sort of a mantra of technology transfer in the computer sciences: You don't transfer ideas, you transfer people."

As optimistic as Laird is about all the possibilities, he has clear ideas about where the field needs to go next. "I would like to see independent, autonomous characters that you have genuine social interactions with," Laird says. "So when you're thinking about moving through the game, it's not solving jumping puzzles or figuring out how to shoot someone – it's figuring out, how can I get this person to work with me in order to solve my problems? Or, what can I do for them so that they then want to help me?" Laird and his colleagues have launched a research project at Michigan to explore the possibilities of this social interaction: an *Unreal Tournament* mod called Haunt 2, in which the player controls a ghost in a house inhabited by NPC "humans." Unable to handle most physical objects directly, the ghost must, in Laird's words, "entice, cajole, threaten, or frighten the AI characters into manipulating the objects in the world."

To be sure, the subtleties of Laird's social interactions are not yet commonplace in today's game AI, which still largely revolves around creating better military bots and training them to hunt down enemies in more believable ways. In a sense, there's something strangely appropriate in that shortcoming: Early artificial intelligences are devoting themselves to the very same problems – hunting, pathfinding, foraging, traversing simple happiness landscapes to satisfy their desires – that wrestled with our ancestors at the dawn of man. Given the progress we've made since those robotic *Space Invaders* first appeared on our screens, can anyone doubt that more nuanced artificial minds, with a more sophisticated emotional repertoire, lie ahead?

Or maybe it's here already. Every now and then – after a successful harvest or the building of a new temple – the villagers in *Black & White* will spontaneously break out into an elaborate group dance, their bodies linked together in ever-changing patterns. If you've trained him properly and he happens to be nearby, your creature may join in the festivities, gyrating along with the Dionysian throng of villagers. Watching those sprites dance on the screen, you can't help but think that these simulated minds are displaying emotions – joy, solidarity, love for life – that are unfathomable in a videogame: That the life in question is artificial might actually be beside the point. ■ ■ ■

Monster in a Box

The inside story of an ingenious chess-playing machine that thrilled crowds, terrified opponents, and won like clockwork.

By Tom Standage

One autumn day in 1769, a 35-year-old civil servant was summoned to the imperial court in Vienna to witness a magic show. Wolfgang von Kempelen – well versed in physics, mechanics, and hydraulics – was a trusted servant of Maria Theresa, the empress of Austria-Hungary. She had invited him in order to see what a scientific man would make of the magician's tricks. The event was to change the course of Kempelen's life.

For he was so unimpressed by the performance that, once it was over, Kempelen made an uncharacteristic and audacious claim. In front of the whole court, he declared that he could do better. Maria Theresa could hardly allow such a boast to pass without comment. Very well, she said. Excusing Kempelen from his official duties for six months, the empress challenged him to keep his word. Kempelen agreed not to return to the court until he was ready to stage a performance of his own.

He did not disappoint. In the spring of 1770, Kempelen reappeared before the empress and unveiled an extraordinary machine: a life-size mannequin seated behind a cabinet. The figure was made of carved wood and wore an ermine-trimmed robe, loose trousers, and a turban. The wooden box was 4 feet long, 2.5 feet deep, and 3 feet high, and rested on four brass casters. This meant the whole contraption could be moved around and rotated freely, so that it could be viewed easily from every angle. The front of the cabinet was divided into three doors of equal width, with a long drawer along the bottom. The wooden figure sat with its right arm extended, resting on the cabinet top, and its eyes stared down at a large chessboard directly in front of it. Its left hand held a long Turkish pipe, as though it had just finished smoking.

Stepping forward to address the audience, Kempelen announced that he had built a machine the likes of which had never been seen: an automaton,

IMAGE: DALE GOLD (PHOTOGRAPH); MORTEN KETTEL (POSTER)

A fast, aggressive player, "the Turk" **beat most people** within half an hour. Its victims included Ben Franklin and, in a dramatic showdown, **Napoléon Bonaparte**.

or mechanical toy, capable of playing chess. A skeptical murmur passed through the crowd. Kempelen explained that before demonstrating his invention, he would display its inner workings. He reached into his pocket and produced a set of keys, one of which he used to unlock the leftmost door on the front of the cabinet. Kempelen opened it to reveal an elaborate mechanism of densely packed wheels, cogs, levers, and clockwork machinery, including a large horizontal cylinder with a complex configuration of protruding studs, similar to that found in a musical box. As the audience scrutinized these workings, Kempelen opened another door directly behind the machinery and held a burning candle so that its flickering light was visible to spectators through the intricate clockwork. He then closed and locked the rear door.

Kempelen returned to the front, where he pulled out the long drawer to reveal a set of chess pieces in red and white ivory; he placed these on the top of the cabinet. Next, he unlocked and opened the two remaining doors in the front to reveal the main compartment, which contained only a red cushion, a small wooden casket, and a board marked with gold letters. Kempelen placed these items on a small table near the automaton.

Leaving all the doors and the drawer open, Kempelen rotated the automaton so that its back was to the crowd. Lifting up its robe, he revealed a small door in the figure's left thigh and one in its back, both of which opened to show more clockwork machinery. Kempelen then closed all the doors and the drawer, replaced the robe, and returned his contraption to its original position facing the onlookers. He slid the cushion beneath the figure's left elbow, removed the long pipe from its left hand, put the chess pieces on the appropriate squares, and reached inside the cabinet to make a final adjustment to the machinery. Finally, he placed two candelabras on top of the cabinet to illuminate the board.

Kempelen announced that the automaton was ready to play chess against anyone prepared to challenge it, and recruited a volunteer – a courtier named Count Cobenzl – from the audience. Kempelen explained that his mechanical man would play the white pieces and have the first move, that moves could not be taken back once made, and that it was important to place the pieces exactly on the center of the squares, so that the automaton would be able to grasp them correctly. The count nodded. Kempelen then inserted a large key into an aperture in the cabinet and wound up the clockwork mechanism with a loud ratcheting sound.

Once Kempelen stopped turning the key there was an agonizing silence. Then, after a brief pause, the sound of whirring and grinding clockwork could be heard coming from inside. The carved figure slowly turned its head from side to side, as though surveying the board. To the utter astonishment of the audience, the mechanical man then lurched to life, reaching out its left arm and moving one of its chessmen forward. The room cried out in amazement. The game had begun.

The sight of a machine playing chess was astounding enough, but the Turk, as it came to be known, also proved to be a formidable opponent. Count Cobenzl was swiftly defeated; the automaton was a fast, aggressive player, and subsequently proved to be capable of beating most people within half an hour. Kempelen, it seemed, had built a mechanical man whose clockwork mind could outthink most humans.

The Turk's sensational performance delighted the empress. Kempelen and his automaton made many more appearances before the royal family, government ministers of Austria-Hungary and of foreign countries, and other eminent visitors to the court. His extraordinary creation became the talk of Vienna, and the news of its triumphs quickly spread throughout Europe.

After the empress died, her son, Joseph II, commanded Kempelen to take the Turk on a tour of the courts of Europe. The inventor and his automaton went on to visit France, England, the Netherlands, and Germany. In Paris, the Turk defeated Benjamin Franklin, who, among his many other interests, was a chess fanatic. It suffered a rare defeat at the hands of a Frenchman known as Philidor, widely regarded as the finest player in Europe. Members of the Académie des Sciences, one of the world's foremost scientific societies, scrutinized the Turk, but they were

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no more able to fathom the secret of its operation than anyone else.

Wherever it went, the Turk inspired a torrent of pamphlets, newspaper articles, and books debating how it worked. Was it operated by a hidden chess-playing monkey? Was a child, a dwarf, or a legless war veteran lurking inside the cabinet? It seemed impossible; one eyewitness flatly declared that there was "no possibility of its concealing anything the size of my hat." Another school of thought suggested that magnetism, which was still only dimly understood, was involved. Perhaps, went the theory, Kempelen directed his contraption from a distance by moving a magnet in his pocket. Yet another explanation proposed that it was controlled by an offstage operator tugging on very thin wires. Or perhaps Kempelen was pushing tiny buttons, built into the Turk's cabinet, to direct its moves. There were also plenty of observers prepared to accept the automaton at face value as a genuine thinking machine.

After Kempelen's death, the Turk was bought by Johann Maelzel, a maker of musical automata who is also remembered as the inventor of the metronome (though he actually stole the design from someone else). Under Maelzel's ownership, the Turk toured Europe for many years. In 1809, it played its most famous game, against Napoléon Bonaparte, who attempted to fool it by making deliberately incorrect moves. After three such tries, the Turk ended the game in protest by sweeping its arm over the chessboard, knocking over all the pieces – to Napoléon's delight. Charles Babbage, the pioneer of the mechanical computer, was another famous opponent; he lost two games to the Turk. Babbage was certain it was under human control, though he was not sure how. But he started to wonder whether a genuine chess-playing machine could, in fact, be constructed.

Deeply in debt, Maelzel fled to America in 1825, taking the Turk with him. The mechanical man made regular appearances in New York, Boston, and Philadelphia, then toured the south and even went to Havana. A 26-year-old Edgar Allan Poe encountered the Turk in December 1835 in Richmond, Virginia. He concluded that it was controlled by someone hiding inside the cabinet, and the following year published an account of how he believed the operator remained hidden. The style of Poe's prose foreshadowed his later mystery and detective stories. Eventually, interest in the Turk waned, and it spent its last days in a museum in Philadelphia, where it was destroyed in a fire on July 5, 1854. After 85 years and countless chess games, the Turk's spectacular career was over.

Kempelen's contraption was, of course, a hoax. It would have been impossible to build a genuine mechanical chess player using 18th-century clockwork technology. That so many people – even those who supposedly had scientific backgrounds – were taken in is not as surprising as it might seem, however. The Turk's debut occurred at the start of the industrial revolution, as the relationship between men and machines was being redefined; it was a time when new technology seemed to offer boundless possibilities. Why not a thinking, chess-playing machine?

That's what the great player Philidor seems to have thought, despite his victory against the Turk in the summer of 1783. That same summer saw the first public demonstration of a hot air balloon, by the Montgolfier brothers, in the south of France. The event caused a sensation in Paris and contributed to an intellectual climate in which people believed anything was possible.

The fabulous lineup of clockwork animals and mechanical men on show in Europe at the time also fostered the idea that the Turk might, after all, be genuine. From their origins as glorified clocks, automata had grown steadily more complex throughout the 18th century. One popular type was the mechanical picture – a painting with moving parts driven by an elaborate mechanism hidden behind or within the frame. Windup ornaments that dispensed cutlery, spices, water, and wine sat on the tables of many well-to-do families; mechanical dancers, animals, and singing birds decorated music boxes and snuff cases. An Englishman named James Cox made an 8-foot-high mechanical elephant encrusted with diamonds, rubies, emeralds, and pearls.

Other famous automata included a writer, a draftsman, and a harpsichord player constructed by Henri-Louis Jaquet-Droz, a member of a Swiss family of clockmakers. He programmed them to write, draw, and play music using irregularly shaped disks, called cams, threaded on to a spindle. As the spindle rotated, spring-loaded levers resting on the cams moved up and down and controlled the motion of the automaton's various parts by pushing

After two games against the Turk, **Charles Babbage** began to sketch out plans for his own thinking machine. This was the genesis of the **first mechanical computer**.

and pulling on connecting rods. By paying meticulous attention to the shapes of the various cams, it was possible to program these figures to make coordinated movements of extraordinary grace and subtlety. Cams can now be found in all kinds of machinery; they are, for example, used to synchronize the opening and closing of valves in internal combustion engines.

The most famous automata of all were built by a Frenchman named Jacques de Vaucanson. In 1737, he displayed a mechanical flute player in Paris to great acclaim and allowed it to be scrutinized by members of the Académie des Sciences, in order to dispel any question of trickery. Juvigny, a French politician, wrote that "at first many people would not believe that the sounds were produced by the flute which the automaton was holding.... The most incredulous, however, were soon convinced that the automaton was in fact blowing the flute, and that the breath coming from his lips made it play and that the movement of his fingers determined the different notes."

Next, Vaucanson built a boy who played a drum with one hand and a pipe held by the other; the sound of the pipe was even more dependent on the air pressure, the tonguing, and the position of the mechanical figure's fingers than the flute player's music was. But it was Vaucanson's third automaton that became his most famous. He decided to imitate an animal; the result, Vaucanson explained in a letter to a contemporary, was "an artificial duck made of gilded copper that drinks, eats, quacks, splashes about on the water, and digests his food like a living duck." It could stretch out its neck, take grain from a spectator's hand, and then swallow, digest, and excrete it. Its wings could flap and were anatomically exact copies of real ones, with each bone rendered in metal and adorned with a few feathers. While spectators were struck by how lifelike it appeared, Vaucanson was chiefly interested in the duck's innards, which he left exposed to view. The insides imitated the digestive process by dissolving grain in an artificial stomach, from where it was passed along a flexible tube and excreted. This involved a significant technological development, since it was the first time a tube had been made of India rubber, or caoutchouc. Such tubing proved to have many other uses.

Vaucanson became a celebrity; Voltaire described him as a "rival to Prometheus." Having built machines that could mimic respiration and digestion, Vaucanson made no secret of his dream of building an artificial man. He hoped it would be possible to use it "to perform experiments on animal functions, and thence to gather inductions to know the different states of health of men so as to remedy their ills."

In 1741, Vaucanson accepted a lucrative offer from the government to apply his mechanical ingenuity to the modernization of the French weaving industry. He drew up elaborate plans to transform manufacturing methods and work practices. But his scheme was abandoned when the silk workers of Lyons, who were to try out his new ideas, complained that they would be herded into factories and forced to act as mere drudges on a production line. Wary of becoming human parts in what would be, in effect, a huge automaton, they rioted in the streets, forcing Vaucanson to flee for his life. He returned to Paris and took a low-profile job as the official examiner of new mechanical inventions for the Académie des Sciences.

Kempelen was familiar with Vaucanson's work and shared his interest in building machines that could imitate human faculties. (In addition to creating the Turk, Kempelen spent many years researching the mechanism of speech, and in the 1770s he produced the first speech synthesizers capable of articulating entire sentences.) He must have been aware that most observers found Vaucanson's constructions incomprehensibly complicated. With the introduction of the steam engine and the power loom across Europe, there seemed to be no limit to the potential of mechanical technology. The Turk cleverly exploited this perception.

There are obvious similarities to the rise of the computer era in modern times. The creations of Vaucanson, Kempelen, and their contemporaries are arguably the ancestors of almost all modern machinery; automata occupied the same intersection of technology, entertainment, and commerce that computers do today. Then, as now, many people were ambivalent about the new machines. On one hand, they were fascinated – public exhibitions of automata were wildly popular in London and Paris during the 18th century – but they were also concerned that humans might end up being superseded. Just as science fiction movies of the 1960s featured evil robots and computers, 18th-century books and plays explored the dramatic possibilities of thinking machines, or of people concealed inside boxes and pretending to be machines. While many of these stories were straightforward comedies or romances, a darker mood was also abroad: The Turk's tour of Europe coincided with the Luddite riots and Mary Shelley's publication of *Frankenstein*.

In the end, the Turk was taken seriously because it provided a starting point for discussion of the promise – and limits – of machinery. Even scientific men who could see through the hoax enjoyed the debate spurred by the Turk. Robert Willis, a young Englishman who in 1821 published one of many books attempting to explain how the Turk worked, founded his argument on the assumption that a chess-playing machine was simply impossible. "The phenomena of the chess player are inconsistent with the effects of mere mechanism," he wrote, "for however great and surprising the powers of mechanism may be, the movements which spring from it are necessarily limited and uniform. It cannot usurp and exercise the faculties of mind; it cannot be made to vary its operations, so as to meet the ever-varying circumstances of a game of chess." Automata might be able to do clever things, he conceded, but they could not respond to events. They could not be, to use the modern term, *interactive*.

Even though Charles Babbage agreed with Willis that the Turk was a hoax, his experience with it led him to exactly the opposite conclusion about machine intelligence. Babbage had long toyed with the idea of building an automaton that could perform mathematical operations, and in 1821, shortly after playing his two games against the Turk, he sketched out his first plans for such a machine. This was the genesis of Babbage's first mechanical computer, the Difference Engine. Although he toiled for many years and spent an enormous amount of money – much of it provided by the British government – Babbage never completed it. One reason was that halfway through construction, Babbage dreamed up an even more ambitious machine: the Analytical Engine, which would be capable of far more complex calculations. He lost interest in the Difference Engine but was then unable to raise funds for his new design. Even so, Babbage's insight into the Analytical Engine's theoretical capabilities prefigured many elements of modern computer science. In particular, he argued that a suitably powerful mechanical engine would be able to play games of skill such as ticktacktoe, checkers, and chess. He even sketched out a rough algorithm for playing board games with movable pieces, including chess – the first time that anyone had attempted to devise one. Babbage concluded that, in theory at least, there was no reason why a genuine mechanical chess player could not be built, though its cost and size would make the idea impractical.

By the mid-19th century, public understanding of what mechanical technology could and could not do was on a firmer footing than at the time of the Turk's debut, and most people had come to regard chess-playing machines as improbable. With the rise of the telegraph – a revolutionary new form of communication – electrical devices began to eclipse mechanical ones as the embodiment of the technological zeitgeist. Little wonder that interest in the Turk declined. A few years after its fiery demise, nobody was terribly surprised when the truth emerged: The chess player had indeed been controlled by a concealed operator using a clever system of folding partitions to remain hidden while the automaton's interior was open to view.

The Turk is gone, but not quite forgotten. It is fondly remembered by historians of magic, chess enthusiasts, and, perhaps surprisingly, computer scientists. Indeed, Kempelen's contraption has taken on a new significance since the invention of the digital computer. Artificial intelligence researchers started writing chess-playing programs in the 1940s, showing just how prescient Kempelen had been in suggesting that the game was a good first step for machine intelligence. And with its setup of a man pretending to be a machine, the Turk anticipated the standard test proposed by British scientist Alan Turing in 1950: A device can be deemed intelligent if it can pass for a human in a written question-and-answer session.

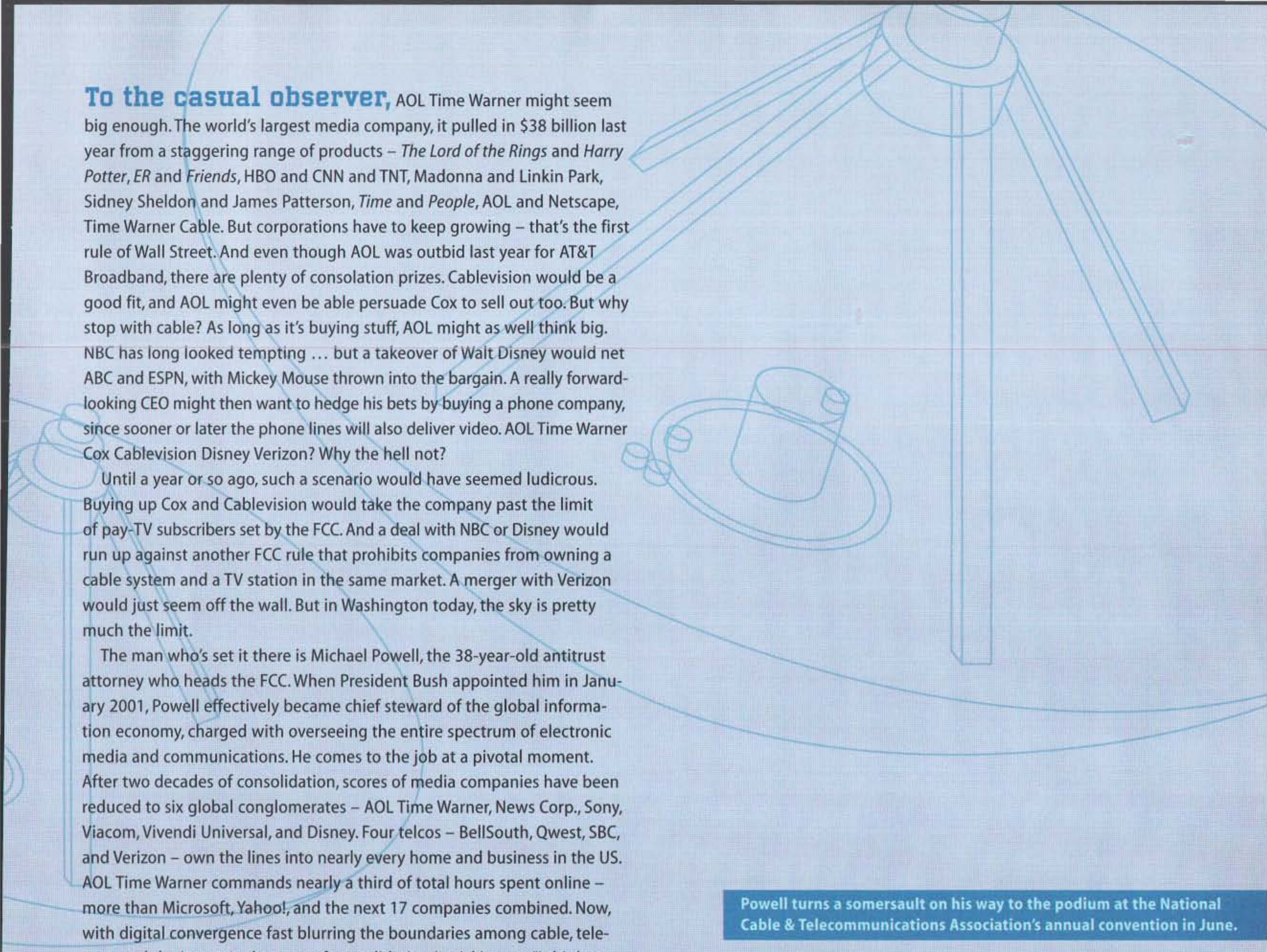
Yet the most fundamental reason for the Turk's enduring popularity has only recently become apparent, following the construction of a replica by John Gaughan, a magician based in Los Angeles. Like Kempelen and Maelzel before him, Gaughan opens and closes the doors of his creation to reveal its empty interior; his Turk then springs into life. Even if you know how it works, the illusion is remarkably compelling. Ultimately, the original Turk's success depended on its spectators' deep-seated desire to be deceived. In more ways than one, Kempelen's chess-playing machine was an illusion that directly exploited the faculties of the human mind. ■ ■ ■

Big Media or Bust

As consolidation sweeps the content and telecom industries, FCC merger maniac Michael Powell has a plan: Let's roll.

By Frank Rose

VIDEO STILLS: NATIONAL CABLE & TELECOMMUNICATION, CABLE 2001



Powell turns a somersault on his way to the podium at the National Cable & Telecommunications Association's annual convention in June.

To the casual observer, AOL Time Warner might seem big enough. The world's largest media company, it pulled in $38 billion last year from a staggering range of products – *The Lord of the Rings* and *Harry Potter*, *ER* and *Friends*, HBO and CNN and TNT, Madonna and Linkin Park, Sidney Sheldon and James Patterson, *Time* and *People*, AOL and Netscape, Time Warner Cable. But corporations have to keep growing – that's the first rule of Wall Street. And even though AOL was outbid last year for AT&T Broadband, there are plenty of consolation prizes. Cablevision would be a good fit, and AOL might even be able persuade Cox to sell out too. But why stop with cable? As long as it's buying stuff, AOL might as well think big. NBC has long looked tempting … but a takeover of Walt Disney would net ABC and ESPN, with Mickey Mouse thrown into the bargain. A really forward-looking CEO might then want to hedge his bets by buying a phone company, since sooner or later the phone lines will also deliver video. AOL Time Warner Cox Cablevision Disney Verizon? Why the hell not?

Until a year or so ago, such a scenario would have seemed ludicrous. Buying up Cox and Cablevision would take the company past the limit of pay-TV subscribers set by the FCC. And a deal with NBC or Disney would run up against another FCC rule that prohibits companies from owning a cable system and a TV station in the same market. A merger with Verizon would just seem off the wall. But in Washington today, the sky is pretty much the limit.

The man who's set it there is Michael Powell, the 38-year-old antitrust attorney who heads the FCC. When President Bush appointed him in January 2001, Powell effectively became chief steward of the global information economy, charged with overseeing the entire spectrum of electronic media and communications. He comes to the job at a pivotal moment. After two decades of consolidation, scores of media companies have been reduced to six global conglomerates – AOL Time Warner, News Corp., Sony, Viacom, Vivendi Universal, and Disney. Four telcos – BellSouth, Qwest, SBC, and Verizon – own the lines into nearly every home and business in the US. AOL Time Warner commands nearly a third of total hours spent online – more than Microsoft, Yahoo!, and the next 17 companies combined. Now, with digital convergence fast blurring the boundaries among cable, telecom, and the Internet, the pace of consolidation is picking up. "I think we are very far from the end of this movement," says Jean-Marie Messier, CEO of Vivendi Universal.

Where will it take us? Powell's not sure – but he's also not worried. "Monopoly is not illegal by itself in the United States," he points out. "People tend to forget this. There is something healthy about letting innovators try

"Powell is abdicating the responsibility Congress has given him," says predecessor Reed Hundt. "It's extraordinarily lawless, and it disserves the country's interests."

to capture markets. What's not healthy is if they can control them in a way that leads to anticompetitive effects for consumers."

Less sanguine observers fear that further consolidation will lead to no good. They see a glimpse of the future in last year's fight for AT&T Broadband, which took a strange twist when Microsoft offered to back either Comcast or Cox with cash in order to keep AT&T Broadband from going to its arch rival, AOL. "Sometimes, in an honest moment, you'll hear someone at the FCC say that Microsoft and AOL Time Warner can police each other," says Reed Hundt, who headed the FCC in the mid-'90s. "But no one self-polices antitrust. What Powell is doing is abdicating the responsibility Congress has given him. It's extraordinarily lawless, and it disserves the country's interests. He proposes to allow the creation of the greatest, most prodigiously sized media conglomerates that have ever bestrode the planet. And he seems massively indifferent to whether markets are competitive."

"Reed will be Reed," Powell responds. "I would say this is sort of melodramatic and preposterous. It's also very interesting that the big companies we're talking about are ones that became big prior to my tenure. To be ranting about abdication – I just think that's sort of amazing, coming from a person who had these responsibilities himself."

Of course, no FCC chief acts alone: The commission answers to Congress and to the federal courts, which last year overturned a long-standing rule limiting the percentage of the market a cable operator can control. But Powell could have appealed the order, or tried to devise a rationale for the cable cap that the court would accept. Instead, he launched a study to see if any cap is justified at all. He's been questioning other FCC rules as well – regulations that keep a newspaper from owning a TV station in the same city, that limit the number of stations a broadcaster can own, that put a ceiling on the amount of spectrum a wireless carrier can buy.

These are the sort of arcane regulatory issues that generate small headlines in the business pages but have huge effects in the real world. And when they involve media companies, which are held to a far stricter standard than ordinary enterprises, the stakes go way up. "It's a very fuzzy area," Powell says, "because it's very hard to find measurable things to have the debate around. Diversity and all that stuff is very important, but it's hard to get a consensus on what it is, other than that the goals are worthy. I mean, if Viacom wants to buy so-and-so, is that the straw that broke the camel's back?"

Which is precisely the question. The story of Viacom is the story of the media business: From its start as a small-time distributor peddling *I Love Lucy* reruns in the 1970s, it's become the world's third-largest media conglomerate, with sales last year of $23 billion and properties that include Paramount Pictures, CBS, MTV, Showtime, the Infinity radio-station chain, and Simon & Schuster books.

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The paradox is that even as Viacom and the others have binged on mergers and ballooned to gargantuan proportions, the choices available to consumers have proliferated. "By any measure the media is wider, more diverse, and more varied than it's ever been in history," Powell claims – and he's right. The reason is technology. Viewers in the '50s had three channels at most; now they have hundreds of channels to choose from on cable or satellite, not to mention alternatives like videocassettes, DVDs, and the Web. Only the number of owners has shrunk.

The telecom business, on the other hand, has until recently been on the opposite trajectory. After decades as a government-sanctioned monopoly, it was forcibly dismembered in 1984 with the court-ordered breakup of AT&T. The Telecommunications Act of 1996, the first major overhaul of communications law in 62 years, yielded an explosion of startups offering high-speed Internet access and other services. Then WorldCom swallowed up MCI and the Internet backbone provider UUNet, and the seven regional Bell companies merged into four, each enjoying a de facto monopoly on local service in its territory. Meanwhile, most of the startups collapsed into bankruptcy as funding dried up. Now we're at the threshold of once-unimaginable combinations. In the near term, the surviving Bells seem destined to win control of the faltering long distance giants, AT&T, Sprint, and WorldCom – and with them, the bulk of the Internet backbone. On a farther horizon, some see the day when the phone companies will merge with the media conglomerates to form a digital hybrid of entertainment and telecom.

Powell views all this through an intellectual prism. He often cites the ideas of Joseph Schumpeter, the Harvard economist who's now, more than 50 years after his death, considered a harbinger of the new economy. Schumpeter is best known for his theory of creative destruction – the idea that innovation and entrepreneurship give rise to a "perennial gale" that wreaks havoc in business, bringing in the new, destroying the old. (See "The Father of Creative Destruction," page 94.) For a Republican trying to balance free-market principles with the task of government oversight, this concept offers some useful tips. Since Schumpeter's gale is "constantly working to undermine the advantages enjoyed by incumbent firms," as Powell once observed, big corporations shouldn't expect protection from scrappy upstarts – and vice versa. Schumpeter's message to regulators, Powell concluded, is that they should encourage innovation by not encumbering businesspeople with inappropriate rules – in other words, they should think twice before interfering.

This is an idea with big implications. It suggests that as these industries converge, the conglomerates that dominate them should be allowed to consolidate further. In a few years' time, a handful of survivors could own it all. "Powell tends to say, 'Let mergers happen,'" says former FCC chief technologist David Farber, who holds a chair in telecommunications systems at the University of Pennsylvania. "But there's a limit to how much you can say that and still have viable competition. Watching where that line's drawn is going to be fun."

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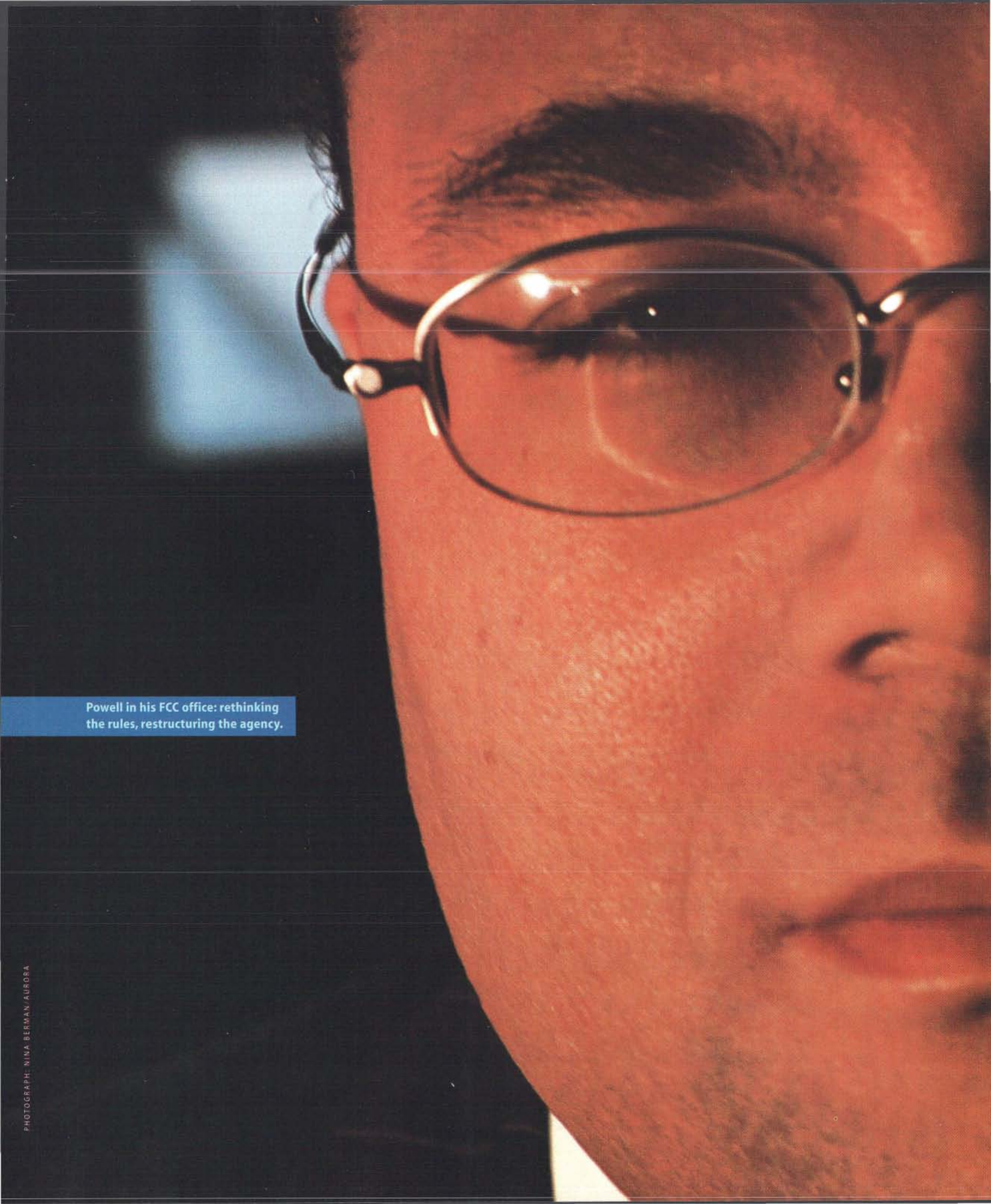
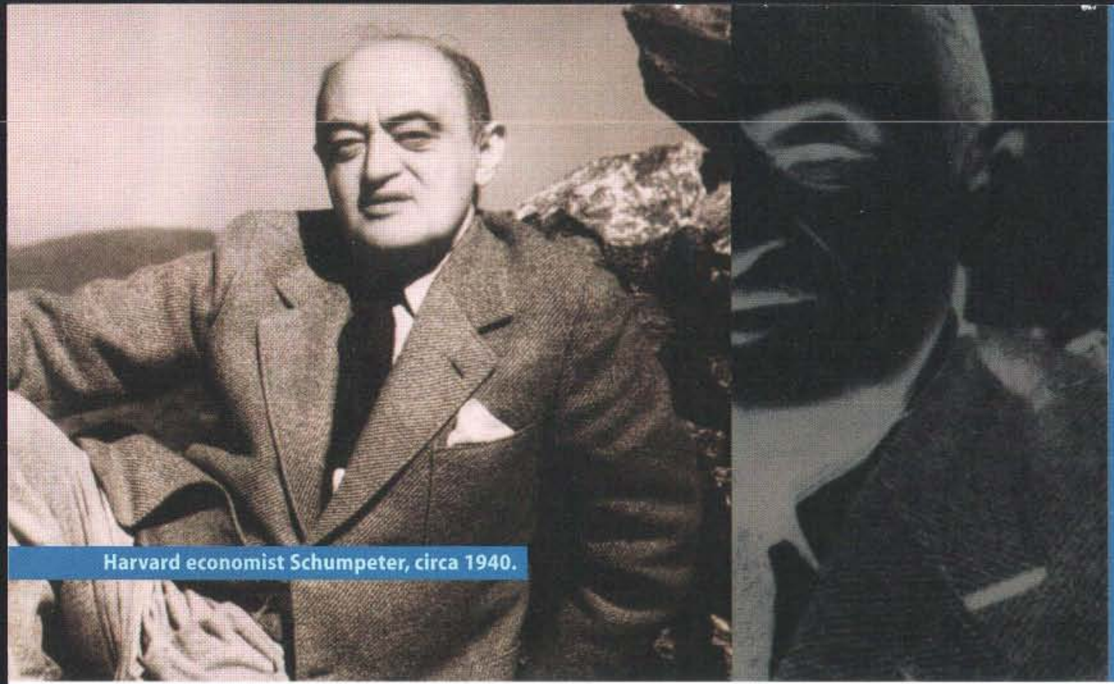


Powell in his FCC office: rethinking the rules, restructuring the agency.

PHOTOGRAPH: NINA BERMAN/AURORA


Harvard economist Schumpeter, circa 1940.

The Father of Creative Destruction

Why Joseph Schumpeter is suddenly all the rage in Washington.

Adam Smith, make room: Joseph Schumpeter has come to Washington. Capital policy wonks may not yet be wearing Schumpeter ties, but the Harvard economist's ideas are cited by everyone from Federal Reserve chief Alan Greenspan to the warring parties in the Microsoft antitrust case.

Schumpeter argued that capitalism exists in the state of ferment he dubbed "creative destruction," with spurts of innovation destroying established enterprises and yielding new ones. This view seems far more current than Smith's Newtonian notion of an "invisible hand" generating stability in the marketplace. Smith was a conceptual breakthrough for Europe, but he didn't say much about bone-jarring technological shifts or the crucial role of entrepreneurship. "It's not difficult to be for Adam Smith and Joseph Schumpeter at the same time," maintains House majority leader Dick Armey. "The market must clean itself out by taking resources away from the losers, so it creatively destroys the losing companies and reallocates resources to the winning companies. That's really what's going on."

> "Schumpeter probably was right all along. But it's only now, at Moore's law speed, that you can actually observe it."

Schumpeter, who came of age in the Vienna of Sigmund Freud, once declared his ambition to become Europe's greatest lover and greatest horseman, "and perhaps also its greatest economist." (Later he said coyly he'd achieved two out of three.) In 1932, he left Europe for Harvard. There he argued that it's entrepreneurs who drive economies, generating growth and, through successes and failures, setting business cycles in motion – a provocative claim in the '30s, when capitalism seemed bankrupt. Even after publishing his landmark *Capitalism, Socialism, and Democracy* in 1942, Schumpeter was overshadowed by John Maynard Keynes, who preached government spending as a way out of the Depression. "Schumpeter probably was right all along," says Michael Powell, "but it's only now, at Moore's law speed, that you can actually observe it."

In a paper presented at a recent Fed retreat, former treasury secretary Lawrence Summers and his ex-deputy Bradford DeLong observed that "the economy of the future is likely to be 'Schumpeterian,'" with creative destruction the norm and innovation the main driver of wealth. Products based on ideas – music, software, pharmaceuticals – require an enormous investment to develop but very little to keep making. And they're often subject to network effects, which reward those that achieve critical mass. Together, these factors – high cost to create, minimal cost to produce, and a winner-take-all environment – tend to generate natural monopolies, at least until the next innovation comes along. How regulators should respond is debatable, but clearly the rules that governed manufacturing economies don't apply.

Yet creative destruction is only half of Schumpeter's message. Far less in vogue is his projection that entrepreneurs will disappear as innovation becomes mechanized in corporate labs – as it has today in Japan – and that ultimately the very success of capitalism will beget socialism. Will creative destruction give way to central planning? Not necessarily, says Harvard's Clayton Christensen. "What happened in Japan is exactly what Schumpeter envisioned," he argues. "But here, folks just leave – they pick up venture capital on the way out, and they start new disruptive corporations." So as long as Washington encourages an infrastructure that supports entrepreneurship, creative destruction can continue after all. – *Frank Rose*

PHOTOGRAPH: HORST-CLAUS RECKTENWALD ARCHIVE, LEHRSTUHL PROFESSOR KARL-DIETER GRUESKE, NUREMBERG

"I'm the United States government, **the one the Constitution warns against," says Powell.** "The public interest works with letting the market work its magic."

An ex-Army officer given to pinstripes and pontification, Powell exudes the comfortable air of a business-as-usual executive. Implicit in his approach to his job, however, is an awareness that he comes to it at a time when convergence is fast changing how all these industries are configured. "Regulation is best when markets are mature," he declares as he settles into an armchair in his office, suspenders peeking out from his navy-blue suit. The room is appropriately expansive, though the location – the top floor of a stubby building in southwest Washington, convenient to an expressway on-ramp but nothing else – testifies to post-Reagan ambivalence about the role of government. "The Bell network was basically the same for 75 years," he continues. "It's an engineering marvel, and I don't mean this disparagingly, but it is tin cans and string at heart. And we understood it. But what do you do when all the cable operators start doing digital telephony? The minute you move to an IP digital architecture, it gets murky."

The most basic problem Powell faces is that, decades after its founding, the FCC remains mired in the New Deal, with separate bureaucracies and entirely different rules for broadcasting, satellite, cable, telecom, and wireless. His overarching goal is to bring this archaic regulatory structure into the digital age. "Powell arrived with a very clear sense of what the future ought to look like," says Mike McCurry, former press secretary to President Clinton. "He does not want to see the regulations of telephony and broadcasting superimposed on the new technologies of the 21st century."

"We've got to figure out how to get greater harmony across the regulatory structure," Powell says, "so consumers aren't denied some cool new gadget because nobody can figure out how to classify it. Cable modem services – even the courts have said three different things. It's a telecom service, it's a cable service, it's an Internet service. The answer is going to have everything to do with how fast the services appear, how well they work, and how regulated they are. IP telephony? This is the coming storm. Telephony is the most regulated communications sector in America, the Internet is the least. God help you when they're the same thing."

So Powell is restructuring the commission, joining satellite, cable, and broadcasting in a single media bureau. But while he's free to shuffle bureaucrats, he can't go too far without congressional OK. Though commissioners are appointed by the president, they function as an arm of Congress, implementing and interpreting legislation. Yet within this framework they have a lot of latitude: Congress decided decades ago to put a cap on the percentage of subscribers a cable company can reach, for example, then left it to the FCC to decide what the cap should be.

The FCC chief's real power is his ability to shape the debate, and here Powell is in a better position to have an impact than anyone in memory. His father is Secretary of State Colin Powell. His chief political benefactor is Arizona senator John McCain, who has a lot of clout on Capitol Hill and sponsored his appointment to the commission in 1997. Powell spent three years as a member of the agency before being named to head it – time enough to learn to navigate the minefields that have disabled some of his predecessors – and his talent for stroking congressional leaders is regarded in Washington with awe. "I'm convinced he'll be an outstanding chairman," says McCain. "Not a doubt in my mind."

Powell's path to bureaucrat began with a stint in the Army, but his career as a soldier came to an early halt. He was a lieutenant in an armored cavalry division in Germany when the noncom driving his jeep fell asleep on an autobahn and lost control. Powell was thrown out of the vehicle, which then bounced on top of him. After a lengthy recovery, he attended Georgetown University law school, where he studied under Joel Klein, who later became the Justice Department's antitrust chief under Clinton. Powell earned his degree in 1993, then clerked for Harry Edwards, chief judge of the US Court of Appeals for the District of Columbia Circuit – the court that rules on suits brought against federal regulators. He went on to become Klein's chief of staff at Justice, where he stayed until Edwards persuaded McCain to push him for an FCC seat in 1997.

Powell should have little problem getting his way on more or less straightforward issues, like restructuring the FCC and rethinking current rules. Two of the other commissioners – Kathleen Abernathy, an FCC attorney turned telecom lobbyist, and Kevin Martin, an FCC attorney turned Bush campaign aide – are like-minded Republicans, assuring him a solid majority on the five-member commission. Nor is he likely to run into trouble with the courts, given his experience in Edwards' chambers. "Michael is very pragmatic," says Klein, who now heads the US operations of the German media conglomerate Bertelsmann. "His going-in view is that if there aren't strong factual reasons for the government to intervene, it should stay out. But he doesn't have a view of the world dictated by theory. The DC Circuit is going to ask tough questions: 'Where are the relevant facts? What is the basis for judgment?' One can have a lot of theory, but the adjudicating court is going to look at the facts."

That's what happened last March, when the DC Circuit voided the cap on cable ownership on First Amendment grounds. "The minute you stray from economic efficiency and anticompetitive issues, you are talking about message," Powell says. "That is something I endorse the country debating 100 percent. But I'm the United States government. I am the one the Constitution warns against. And that's what's at issue in the DC Circuit – the courts will not issue a blank check to the government to stray into diversity and media without a more informed and substantial basis for doing it." So Powell created a working group to get the facts. "Every one of these rules has been waived at one time or another. So why are we having food fights inside the Beltway about what will happen? Why aren't we out there examining what *really* happened?"

But even if Powell's study justifies his inclination to revamp the media ownership rules, it won't get him any closer to his larger goal of updating

"I'm an old tank soldier. I think some things are just dirty and messy, and telecom is one of them."

the entire regulatory structure to acknowledge the reality of convergence. To do that he'd need to persuade Congress to revisit the Telecom Act, and that's a can of worms no one wants to pop open. "The 1996 Telecommunications Reform Act was neither about telecommunications nor reform," asserts McCain. "It was all about special interests. You have too much money in campaign contributions, and they offset each other, so we're in gridlock." If the same money had been put into delivering broadband, McCain says, "they could have wired every home in America."

There's another reason Powell won't be moving America's regulatory structure into the 21st century anytime soon: He'll be too busy with all the mergers coming up. At the top of his agenda is EchoStar's $32 billion acquisition of Hughes Electronics, whose DirecTV subsidiary is the only other major satellite television service in the US. Then there's Comcast's deal to buy AT&T Broadband. While the Justice Department has primary responsibility for merger reviews, it's the FCC's job to decide if mergers are in the public interest – and that's a concept Powell has a hard time grasping. He once compared the public interest to modern art – "people see in it what they want to see" – before declaring last year that "the public interest works with letting the market work its magic." Still, he's not going to sit these cases out: Four days after the Hughes-EchoStar deal was announced, he appointed a committee to review it.

More deals are in the offing, particularly in telecom, where the Bells look like winners. With the startups that sprouted to challenge the Bells dying off, the long distance carriers – AT&T, Sprint, and WorldCom – are left to fight them alone. But brutal price wars and competition from wireless have slashed their profits, and now the Bells are moving in for the kill. The Telecom Act allows them to offer long distance once they can show they've opened their local networks to competition – which they're finally doing, now that most of the newcomers are dead. That means the Bells can bundle local and long distance into one package, an offering the long distance carriers can't easily match. "Where do we fit in?" says Vonya McCann, Sprint's chief lobbyist in Washington. "That's our concern. Are we a niche player? I don't know."

Most likely they'll end up as nice little units of the Bells. Last fall AT&T, having just sold off its wireless unit, broached the idea of selling the rest of itself to BellSouth. BellSouth wasn't interested, but it did start talking with Sprint. There's little doubt what will happen next. "In the next 12 to 18 months there's going to be a massive and historic consolidation," says Blair Levin, who served as Reed Hundt's chief of staff at the FCC and is now an analyst at the investment bank Legg Mason. "The Bells are going to end up owning most of the critical assets of the long distance carriers" – not just the long distance business, but their Internet backbone. "The math is pretty simple."

At this point, some telecom mergers might be a good thing. Clayton Christensen, the Harvard management guru who wrote *The Innovator's Dilemma*, argues that until emerging technologies like broadband mature, we need big corporations that can supply every piece of the puzzle, as IBM did with computers in the '50s. "When you're using new and poorly understood technology," he says, "you have to do everything in order to do anything." By pushing for an end to wireless spectrum caps, Powell has encouraged mergers among the six competing carriers – mergers that should allow the survivors to get better terms from equipment and handset suppliers, develop more appealing mobile Internet services, and move more quickly to third-generation networks. Christensen says the same principle applies to DSL, the technology that converts voice lines into high-speed Internet connections: "NorthPoint" – a now-defunct DSL provider – "tries to plug into the Bell infrastructure, but even if the people who run Verizon were perfect Boy Scouts, it's not possible. Regulation cannot decouple an industry where the product is not yet good enough."

This runs counter to the thinking behind the '96 Telecom Act, which the FCC interpreted under Hundt to benefit the startups that were making a run at the Bells. Powell isn't prepared to abandon the goals of the Telecom Act outright, but he does wonder why anyone would expect the Bells to give up without a fight. "A hundred years of legacy monopoly wasn't going to be magically unraveled in five years," he says. "I genuinely believe that in more realistic time frames – 10 years, 15 years, 20 years – this country's telecom market will be more competitive than any in the world, because technology is relentlessly improving. But it never happens on some beautiful, straight-line trajectory. The telegraph didn't happen that way, electricity didn't happen that way, television didn't happen that way. I'm an old tank soldier. I think some things are just dirty and messy, and this is one of them."

The logic of convergence suggests that the consolidation trend won't stop with telecom. In the US, media conglomerates looking for distribution have rarely ventured beyond the obvious – broadcasting stations, television networks, and cable systems. But Jerry Levin, the outgoing CEO of AOL Time Warner, recently predicted at a breakfast discussion in New York that media conglomerates and telcos will eventually decide they belong together. This is already occurring in Europe; one of the biggest proponents is Vivendi Universal, which owns a leading French wireless carrier and has partnered with Vodafone, the world's largest wireless company, to set up a pan-European Internet portal. "I was not expecting such a strong endorsement of our strategy from the CEO of AOL Time Warner," quips Vivendi's Messier, who also spoke at the event.

A handful of media-telco combinations were tried and abandoned in the US in the mid-'90s – most notably Tele-TV, a consortium set up to develop programming the Bells could distribute once they'd perfected DSL or replaced their antiquated copper lines with high-speed fiber. The telco execs were good for a few laughs in Hollywood, but what really doomed Tele-TV was the '96 Telecom Act, which promised the Bells the chance to get into long distance. "It became clear that it would be easier to generate profits from long distance than to spend the money to upgrade the telephone lines," says Sony Corp. of America chair and CEO Howard Stringer, who headed Tele-TV at the time. "I think ultimately wireless is the way to go."

Telcos today are hamstrung: "They need to invest so much money in upgrading their networks that they have no flexibility," says Messier. "But they will definitely need to be supplied with content" – as NTT DoCoMo's wireless i-mode service in Japan is supplied by the likes of Sony, Bandai, and Disney. Meanwhile, content companies need distribution – and there's nothing better than having a line, be it telephone or cable, into the consumer's home. That gives them a direct billing relationship with the customer; it also gives them leverage against the competition.

If you're a media mogul, and a key distribution pipeline is owned by a competitor, you want to own an equally critical pipeline so you'll have some bargaining chips when it's time to talk access. Otherwise, bad things can happen. Two years ago, while the government was reviewing the AOL-Time Warner merger, Time Warner Cable and Disney's ABC network were having trouble coming to terms on a new contract – so Time Warner simply yanked ABC off the system. "They pulled our signal on midnight Sunday," recalls Disney lobbyist Preston Padden, "and on Tuesday morning *The New York Times* ran a picture of a group of nuns who'd gathered to watch *Who Wants to Be a Millionaire* – and they were all crying. I knew then we were going to win. You can't do better than nuns crying in the *Times*."

ABC got back on Time Warner Cable in short order, but the lesson was not lost on anyone: Distribution means power. Seagram CEO Edgar Bronfman Jr. had already concluded that his Universal entertainment subsidiary needed pipe; within weeks, he sold the whole company to Vivendi. Then Viacom bought CBS – the network, the TV stations, the radio stations, the works. "Consolidation always justifies consolidation," declares Blair Levin of Legg Mason. "I'd feel better if I had a sense of how these companies are going to compete with one another and not simply divide the markets."

That's where the facts give out and faith kicks in. Ultimately, this is what Powell's views rest on – his faith in technology's ability to fuel the process of creative destruction. In the digital world, says Powell, "everything can grow fast. Everything has network effects. And there is not a business out there that isn't trying to capture the market. So how are you going to respond? Are you going to apply the classic anticompetitive overlay and say, 'Let's drop the hammer'? Schumpeter teaches that what you're observing could be nothing more than a new innovator who is on top maybe for only a moment, or who is on top because he deserves to be, because he took risks and did it. If that's the case, government should be much more reluctant to dislocate his company from its naturally won advantage."

Not that anyone would mistake the corporate giants that dominate media and telecom for innovators. The list of missed opportunities is endless: Broadcasters got free spectrum to go digital but have left it untouched for years; interactive television, long a reality in Europe, remains a visionary concept in the US; wireless carriers are still trying to figure out how to make a go of the mobile Internet without moving to Japan. Given past behavior, are the titans of the communications industry more likely to fight the future than move us toward it? "I have the same concern," says Powell. "But I demand better reasons to take action than just, you can articulate a set of speculative horribles that might happen."

Meanwhile, out there beyond the corporate walls, the innovations have kept coming. Network viewership has been dwindling for years, thanks to the introduction of cable and satellite. Television as we know it is threatened by personal video recorders that can bypass advertising and make time slots irrelevant. And though the recording companies have beaten back the free-music bogeyman with a massive legal onslaught, they're still struggling to get out of shrink-wrap. In New York and Hollywood, fear is palpable: The news and entertainment industries of the 20th century are in danger of being creatively destroyed. "You can't rest on your laurels at all," says Stringer, the Sony exec. "The *quo* will lose its *status* instantaneously in the brave new world that Michael Powell is talking about. It creates a permanent anxiety, which is why many of these mergers take place. You protect yourself against the dark stranger around the corner – and you hope he's put off by your size."

There's another factor at work, too. "A lot of the acquisition frenzy is really driven by the mathematical need to grow," says Clayton Christensen. "You can't forecast down revenues – that's not acceptable. And yet growth is like a heroin addiction – there were things that satisfied your addiction when you were little, but once you've merged you need twice the kick." Big companies aren't looking for little scores, even if they might become big scores later on – which is why innovations so often come from outside.

Nonetheless, Powell believes. "When my 12-year-old is 22, I think he's gonna look out and see an absolutely wonderful communications environment," he declares, his voice turning rosy. "And where do I get that optimism? No matter what the failings of particular businesses or the government, technology is relentlessly improving. That is a wild card that can't be altered. This stuff keeps changing the world, and I believe there are enough entrepreneurs left in America that some of them are going to emerge from a basement or a garage, given half the chance, and harness it."

In Schumpeter's world, anything can happen – as, in fact, some of the issues on Powell's docket attest. AOL Time Warner may threaten its competitors in dangerous new ways, and like any company it could turn complacent and stodgy. But the fact remains that a scrappy little online startup from the DC suburbs has taken over the world's most powerful media empire. That's the kind of upset Powell is betting will keep happening again and again. ■ ■ ■

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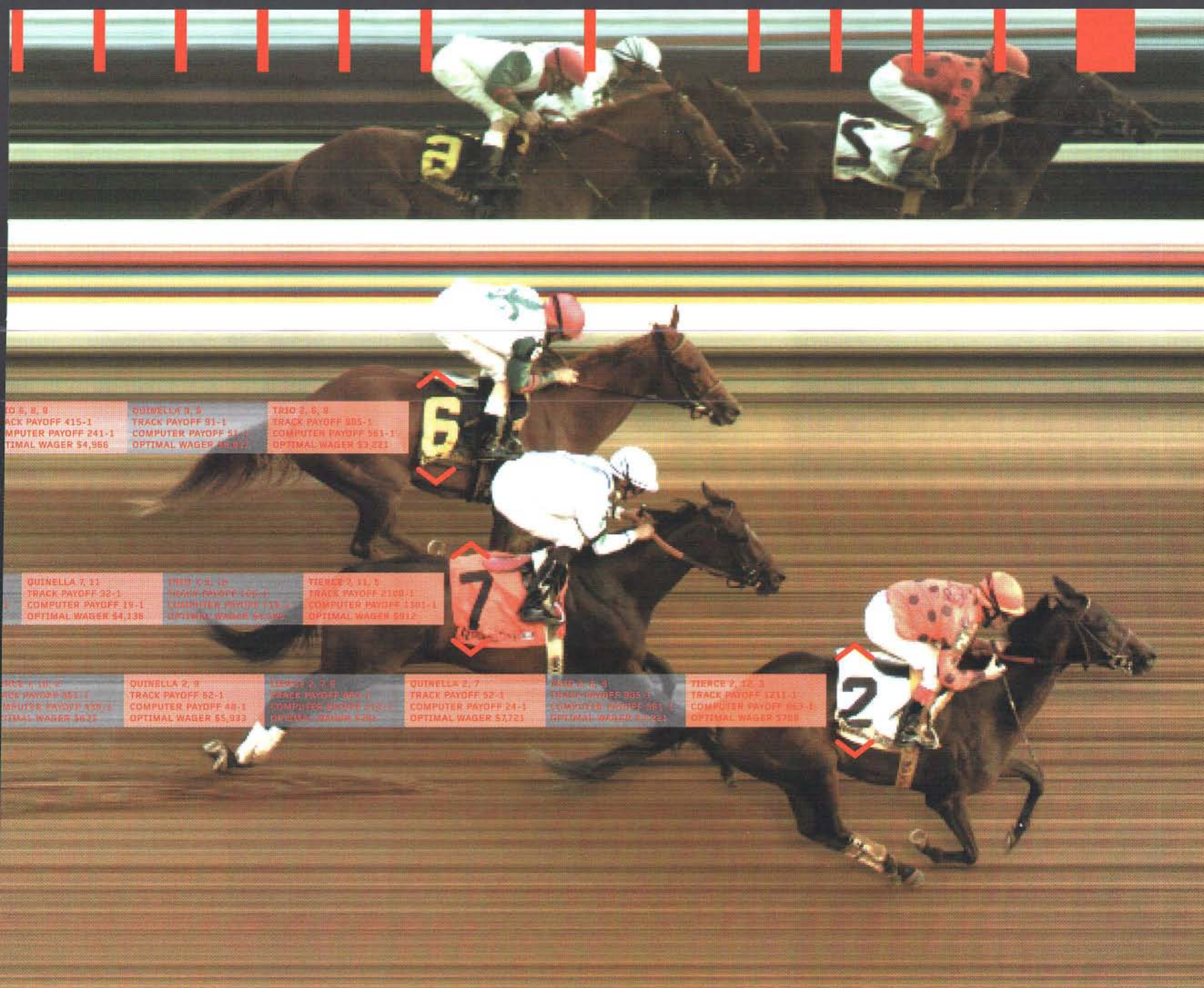
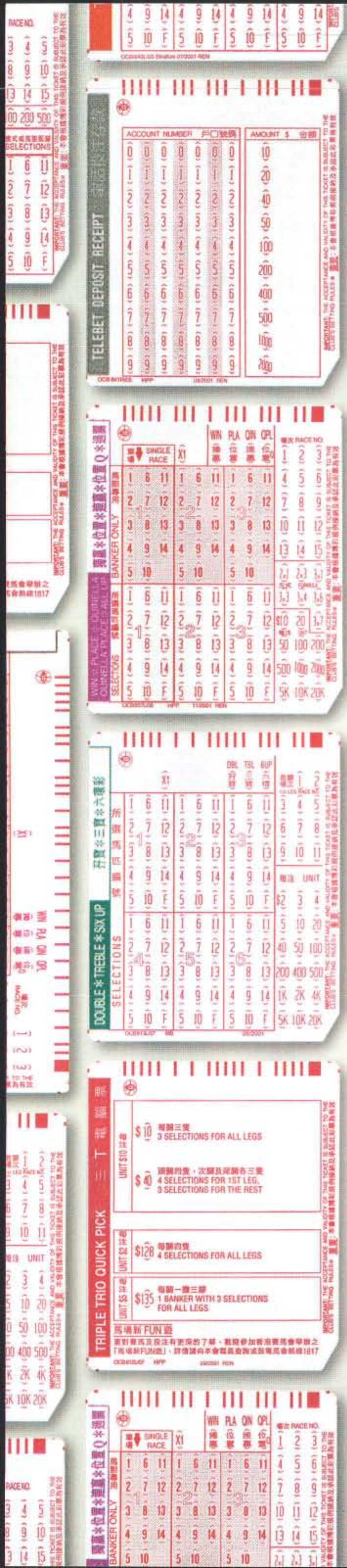


THE HIGH TECH TRIFECTA

BY MICHAEL KAPLAN

They've got multimillion-dollar bankrolls, lightning-fast networks, and a probability-crunching system that leaves the odds in the dust. Meet the pari-mutuel fund managers who are redefining horse racing.



Crisscrossing telephone wires snake along the carpeting of Rod Dufficy's cluttered home office near Hong Kong's Happy Valley racetrack. Dressed down in baggy black velour sweatpants and a matching gym shirt, Dufficy, 32, sits at a large L-shaped desk, rocking back in his chair and eyeing three computer screens crowded with numbers. He is cramming for a race that begins in 22 minutes, calling up information from an online database and sifting it through a betting-analysis program built into his system. The Australian is one of Hong Kong's elite breed of super-successful professional gamblers, computer-assisted horse bettors who work in teams and net millions at the races each year. Tonight, however, is not one of Dufficy's big-money sessions; he is down US$300,000 heading into this race. "I'm going to have a lot of outlay on this next one," he says. "Maybe $550,000."

Three slender Hong Kong sisters face Dufficy, waiting for a printer to spit out a list of a couple hundred bets with potentially big payoffs. One sister grabs the sheets and snips them into strips, which she distributes to the other women. They punch the information into their handheld wagering machines, which transmit it to the track via telephone lines, filling the room with the chirping of outgoing data.

Four minutes and three-quarters of a mile later, Dufficy looks up at a large-screen TV and watches thoroughbreds lunging past the finish line. He scrutinizes a fistful of papers, then scans the race results scrolling across his desktop monitor. "We've got wins – quinellas and a tierce," he says calmly, referring to wagers that required selecting the first two and three finishers. He made $330,000 on this single race. "It'll put me ahead by $30,000 tonight," he says. By week's end, his earnings will add up to a profit of about $130,000 for essentially two days of work – a typical cycle for Dufficy, who, in fact, wagers and wins less than some other computer-assisted bettors in town.

But there's plenty of dough to go around. As Dufficy and members of the half-dozen or so computer teams in Hong Kong will tell you, this city stands as the land of opportunity for tech-inclined handicappers. The allure centers on Hong Kong's massive handle – the total amount of money wagered on each race – which is the highest in the world. It allows the teams to lay hundreds of thousands of dollars on a single race without upsetting the odds. But Hong Kong racing has other attractions as well: Run by the not-for-profit Hong Kong Jockey Club, it is scrupulously honest (fixing would hurt computer bettors' calculations), and there is a pool of only 1,200 horses per season (a manageable number for the teams to track performances). Then there are the extravagantly exotic bets and parlays, comprising a rich smorgasbord of financial opportunities that seems custom-made for the computer teams. One, the Triple Trio, requires picking the top three finishers in three races and routinely pays six-figure dividends.

Unlike other sports, in which bookmakers subjectively set the betting odds or point spreads, horse racing is built around a pari-mutuel system. Payouts are based entirely on the public's opinions, expressed by the horses they bet on. Horses that receive the most bets have the shortest odds and pay the smallest dividends; the least popular horses pay best because fewer people need to divvy up the pool of money. In a pari-mutuel system, the house has no edge and no interest in who wins. (At the end of a race, the track earns only the fee charged for handling each bet; in Hong Kong it's 19 percent of the wagers, which total about $10 billion each year.) Therefore, someone with the right research capabilities can easily find the public's miscalculations and exploit them for great financial gain.

Computer teams pick their winners by culling data from past performances. They use custom-tailored software programs to determine their own odds, search for overlays (situations in which their odds – the calculated, objective odds – are more advantageous than the public's typically subjective odds), and place bets that can deliver big dividends for reduced risk. Team leaders provide the multimillion-dollar bankrolls, supplemented with investments from the 30 to 40 other members. Their jobs range from accounting to code writing to placing the bets. Annual salaries start at $50,000 for those who enter the wagers by phone and rise to more than $1 million for chief technology officers.

The teams are usually headed up by Westerners or Australians; insiders speculate that Chinese gamblers are inclined to emphasize fate and numerology and therefore find computers and horses incompatible. These team leaders walk off with what's left after salaries and operating costs. William Ziemba, alumni professor of financial modeling at the University of British Columbia and a longtime observer of the scene, estimates that a top-notch outfit can pull in as much as $100 million in a good season, netting the boss a cool $50 million or more.

"Computer teams are at a terrific advantage," explains Richard W. Munchkin, author of the forthcoming *Gambling Wizards*. "Imagine if Fidelity were the only professional investing company, and all the other investors were amateurs who chose stocks at random, on the weekends, for entertainment. Fidelity would be making a lot of money at the expense of those less serious investors."

While computer-generated horse picking is not particularly new, it has reached an apex of sophistication

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PREVIOUS SPREAD: COURTESY AMERICAN TELETIMER AND CHURCHILL DOWNS

in Hong Kong and is spreading beyond China. Teams have recently made inroads in the United States and Japan. You can easily spot tech bettors at the track in Tokyo because they're the ones wheeling suitcases filled with yen. In the US, seven-figure windfalls are unlikely because of small racetrack handles, but pick sixes (choosing the winning horse in six races) paying over $100,000 are possible.

In Hong Kong, computer-assisted teams are not illegal, but the Jockey Club frowns on the practice, and some bettors claim the HKJC has shut down their accounts after it discovered they were connected to teams. "I'm running out of trustworthy people to hold accounts for me," half-gripes, half-brags one Australian bettor. While complaining that his wife's account was canceled, he is well aware of the professional gambler's credo: If they're not throwing you out, you're doing something wrong.

Competition among Hong Kong's computer teams is fierce. Technological secrets are closely guarded, nobody's keen to publicize their betting strategies, and the cagiest players aim to hide their wagers from other teams – all of which monitor the flow of racing money via an independent online service called Telequote, based in Hong Kong. Nobody's more skilled at masking bets than Bill Benter, regarded by many of his peers as the most successful sports bettor in the world: "Normally, you'd see the odds go from 141-1 to 116-1 and know it's got to be a big professional bet," says Dufficy. "But Bill has his betting model set to disguise his action with little $5,000 dribbles. He ultimately puts the right amount on a horse, but he does it over a sequence of time. He leaves no footprints, and that drives other bettors crazy."

The prevailing paranoia is summed up by a rebuffing email from another big player, who refused an on-the-record interview, chiding: "To highlight what I do only INVITES competition, so a high tech magazine is the least desirable place to have an article about me appear. Plus, any publicity is also [very bad] in terms of impact on the Jockey Club. They do not like computer teams, so advertising how much we make [will only hurt us]." Nonetheless, several team leaders agreed to talk about their operations, though not for attribution.

Working from mathematical models that are calculated to deliver a 24 percent return on investments, Hong Kong's most sophisticated computer-assisted bettors operate with long-term certainty of what their profits should be. "Racing is becoming more and more like a stock market model," says Ziemba, who specializes in statistical analysis and edited *The Efficiency of Racetrack Betting Markets*, a collection of scholarly papers on the mathematics of horse wagering that includes a chapter by Benter outlining the system used in Hong Kong. Horses should be thought of as Microsoft or Dell, Ziemba says, and their past performances are the equivalent of economic charts that provide fodder for the Street's quantitative analysts. "Racing is a financial market catching up with the rest of the world. One big difference, though, between the stock market and a horse race is that you can choose when you want to take your profits from a stock. With horses you must do it at the end of each race. So there is a lot more action."

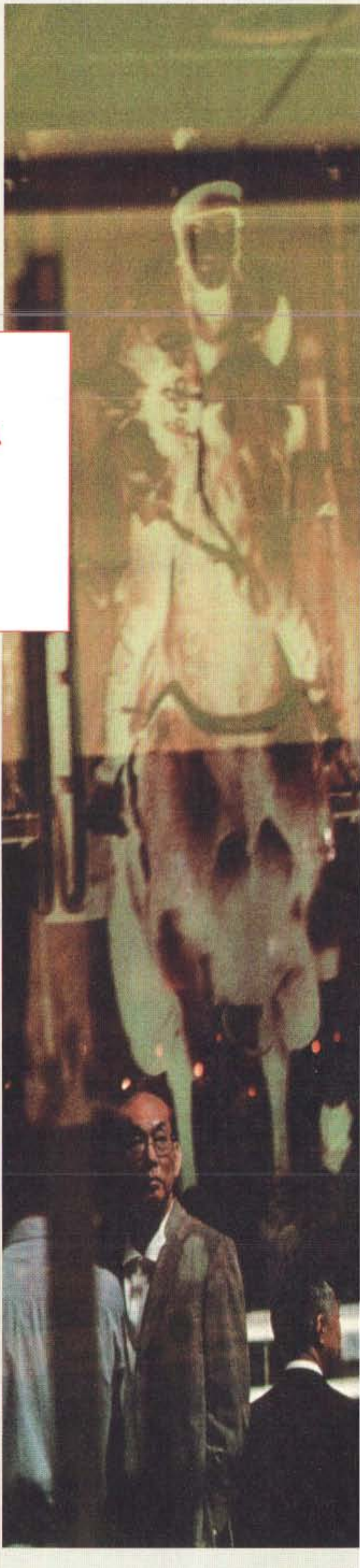
The bedrock of a predictive betting system resides in a massive collection of data on each horse – including details about the tracks and jockeys. "You massage all of that information into a mathematical equation that can be used for predicting probabilities," he explains. "If you wanted to get started in this, you would spend a year building the probabilities system, and it could cost $1 million to put together." And that data bank needs constant updating.

> "Racing is becoming more and more like a stock market model," says one insider. Horses should be thought of as Dell or Microsoft – their past performances are the equivalent of economic charts.

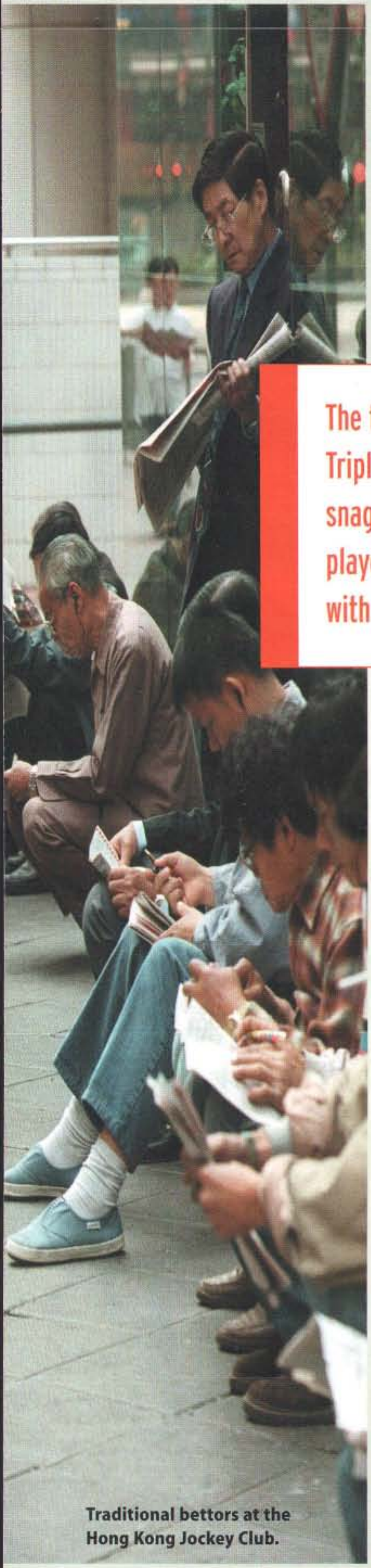
Benter, for example, has employees whose sole job it is to review race tapes after every meet. They judge each horse on 130 characteristics – attributes like speed during the first third of the race, whether it got bumped coming out of a turn, the quality of its recovery from the bump, and, of course, how it finished – and assign numerical grades. This information goes into the database, where it can be cross-referenced and called up to help predict the outcome of any impending race that particular horse runs in.

The computer essentially simulates the race before it happens, based on what has transpired in the past and any anticipated conditions in the future. The software then determines each horse's likelihood of winning a race. When a horse's computer-generated odds are better than the public's odds, the team slams in its wagers. "You create a model that can analyze each type of bet, judge the conditions [in terms of money in the pool and the associated odds], and tell you when it will be most favorable to bet," explains Ziemba. "You do not necessarily want to bet a ton every time – you only do it when you can find advantages."

One top bettor explains it like this: "Our computer program churns through the history of the horses and



PHOTOGRAPH: CHIEN-CHI CHANG/MAGNUM PHOTOS



Traditional bettors at the Hong Kong Jockey Club.

adjusts all the probability in a very sophisticated way. Having established the probability of the horses, we feed that into our betting program, which looks at all the odds for the various outcomes. It looks at your true chances of winning with the latest payoff odds and calculates what the best potential bets are, based on the chances of winning and the odds. Then it runs through all the probabilities.

"The mathematical aspect involves [following] a basic formulation that all successful gamblers use – whether they know it or not," the bettor says. "It's having what mathematicians call a positive expectation on the bet. You multiply the probability of winning times the payoff odds of one bet. Let's say the horse is 20-1. If it has a .05 probability of winning, you multiply that by 20-1. You get 1.0 – or 1-1 – and that is a fair payoff bet.

The teams excel at complex bets. The biggest Triple Trio ever, paying $18 million, was snagged by a pair of computer-assisted players who covered 900,000 possibilities with wagers totaling $1.2 million.

"But if that same horse is paying 25-1, then it has a positive expectation. Now it is 1.25 [or 1.25-1]. It gives you a 25 percent edge. Given that you know the true probability of winning, the amount to bet is a closed-form problem based on how much you can lay down without hurting your odds."

Designing the software to do all this is a delicate operation with seemingly endless pitfalls that can disastrously skew the results. "You have to understand," says Ziemba, "that building this system, maintaining it every week, and updating the model once a year is a lot of work." And doing the work does not necessarily guarantee success. Benter went broke at least once before his system was efficient enough to turn a steady profit. "Every year, more and more people come here and leave with their tail between their legs," says Dufficy.

Whoever writes the team's software needs to decide early on which aspects of a horse's performance to take most seriously. For instance, if a debuting horse's odds of winning are 50-1 and it wins its first race, the software will note that – and might be inclined to view untried horses with long odds as good bets. So the system must be tweaked to give little weight to those outcomes.

Other, more ambiguous factors – turf firmness, recent time trials, second-place finishes, and the jockeys' racing styles, to name a few – must also be taken into account. "Memory is another thing," suggests Kelly Busche, an economist who has taught at Hong Kong University and consulted for one of the major teams in town. "How quickly do you *discount* information? And to what degree? What happened two seasons ago should carry less weight than what happened last season. You need a model and a database that are both agile and robust enough to handle a variety of ever-changing situations."

To build a good horse racing model, teams rely on workers with the skills of hedge fund technicians. Rumor has it that one of the teams has wooed programmers from Fortune 500 companies. "You need a hardcore nerd who is good with numbers and has a mathematical and engineering background," says one team leader. "What we do with computers here is similar to what you see with Deep Blue. It's about attacking problems by fussing around and fine-tuning rather than using intuitive knowledge."

Bettors believe the Jockey Club created big, complex bets like the Triple Trio as a hedge against the computer teams' skill-based advantages. The idea was that such wagers would be impossible to handicap, thus enhancing the luck factor and leveling the field. But things have not worked out that way. The biggest Triple Trio ever, paying a dividend of $18 million, was snagged by a pair of computer-assisted players who covered 900,000 possibilities with bets totaling $1.2 million. The top teams routinely make their fortunes through complicated parlays, quinellas, and exactas.

Never mind that most teams risk huge sums for their reward and shell out an estimated $95 million in commissions. The HKJC remains – at least publicly – unimpressed. "We are worried that if you have the computer people, then your average customer sees himself as having no chance," says Winfried Engelbrecht-Bresges, the HKJC's executive director of racing. "But they're the bettors who bring us 95 percent of our revenue."

The story of computer-assisted betting in Hong Kong begins with Bill Benter, the US-educated, impeccably dressed technician who developed the first successful program put to use at Happy Valley. The importance of his pioneering work is confirmed by rivals and experts alike. Benter got his start in the mid-1970s, when he discovered *Beat the Dealer*, a bible for blackjack card counters. He memorized the best-selling book's strategies and hit the casino circuit, where he met his future partner Alan Woods, a former actuary turned counter. It was in Las Vegas that Benter stumbled upon a slender handicapping guide – and turned from casinos to horse racing.

Equipped with a $150,000 bankroll provided mostly

PHOTOGRAPH: DUSTIN SHUM/SOUTH CHINA MORNING POST

by Woods, the two card counters planned to apply the theories of winning at blackjack to winning at the races. *Beat the Dealer*, after all, had been written with the aid of a computer that analyzed every possible situation at a blackjack table and assigned numerical values based on which cards remained in the deck. The idea, when you follow that best-selling guide, is to rigorously stick to its formula and bet high even when you have only a tiny advantage. In the long run, despite frequent fluctuations and potentially long periods of losing, you will win a prescribed percentage of money. By the time Benter refined his program to the point where it worked consistently, he and Woods had bitterly fallen out over money disputes. But in the end, each wound up with an odds- and probability-crunching machine – both built by Benter.

More than a decade later, Benter seems to have more in mind than just being a racing guru. He's lectured at Hong Kong universities, consulted with internationally known mathematicians, and branched out into other technological endeavors (one is a digitized transcribing system for doctors). He's also served as president of a Hong Kong Rotary Club and made substantial donations to respected charities.

Woods is still on the scene, but his working style is described as being completely different from Benter's. He uses off-the-rack Pentium computers, still runs DOS, and employs an out-of-print program called Revelation for his database. At its core, it remains the original system created by his former partner, customized so that Woods can override it with his personal input. Benter now works with Sun Microsystems processors and uses the far more stable Unix operating system. His setup is said to be much more finely tuned than Woods', allowing him to reach conclusions with limited human interface, thus permitting fewer opportunities for subjective opinions to foul up the beautiful mathematics. When Benter's winners cross the finish line, you don't hear so much as a whoop from his crew. As any fan can tell you, the real miracle of this technology is that winning fails to come as much of a surprise.

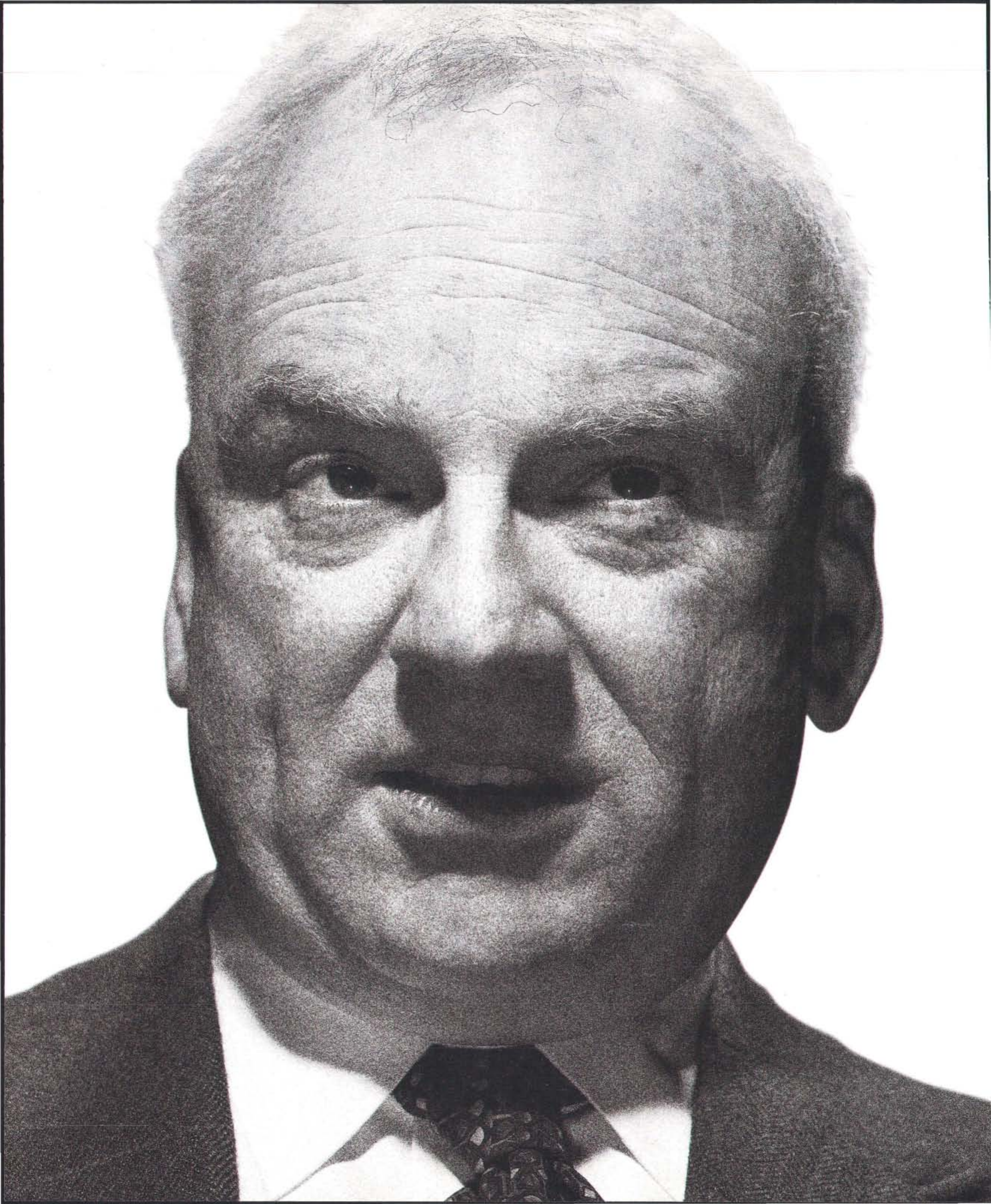
The Hong Kong model seems to be catching on. Consider that as the horses bolted from the starting gate at Gulfstream Park in Hallandale Beach, Florida, one day in February last year, the odds for the winning horse suddenly went from 10-1 to 8-1. A gambler reported the shift to Gulfstream's vice president of finance, Bob Zambreny Jr., who did a bit of investigating. He discovered that in a three-second span, 167 exacta wagers were placed from an outfit in Fargo, North Dakota, called Racing Services – a discreet betting parlor that attracts sky-high wagers with low commissions and liberal rules. Further snooping uncovered a computer team operating in the United States using handicapping software similar to the systems used by Hong Kong teams.

Zambreny and Racing Services decline to identify the team leader. But whoever it was had a special interface that allowed him to batch his bets – to place dozens of wagers per second – into the Racing Services system. This allowed the team to lay down a skein of complex exacta wagers after nearly all wagers were in, the odds were practically set, and it was relatively clear as to how much could be staked before upsetting the odds beyond a tolerable degree. The bets, automatically placed by the computer, ultimately paid out $246,020 on a total bet of $25,569. Even more impressive, over a 50-day period, the team had reportedly netted $3.3 million in profits on $12.9 million in bets.

Gulfstream quickly barred the team from using a computer to place bets, asserting that all bettors must have an even chance. But Susan Bala, president of Racing Services, plays down the unique access granted to the team and says she would let any customer place his wagers via computer from her shop. "We haven't had Joe Blow come in off the street and ask us to let him use his computer in here. But if he did, we would talk to him. We're a service company." Computerized betting is giving horse racing a much-needed dose of pizzazz, Bala argues. She hopes that computer-assisted betting will attract the same people to racing who once devoted afternoons to daytrading. "Technology is driving horse racing to new places," she says.

Other racing professionals are beginning to come around. After the Gulfstream incident, US racing executives discussed the possibility of introducing computerized betting. "I can see a future where patrons would be able to plug their laptops into docking stations," acknowledges Zambreny. "They would deliver their bets through computers and the batching of bets would be possible." Barry Schwartz, chair of the New York Racing Association, welcomes high tech action: "Computers are simply another tool for handicapping. There's no guarantee of winning just because you're using one. These bettors are willing to risk money just like everyone else."

No guarantees, but the evidence from Hong Kong suggests it's the closest thing to a sure bet. There, the models have been taken as far as they can go, and it will be up to a new generation of Benters to tweak them for use in other locales. As handicapping systems seep into the mainstream, the innovators anticipate a future involving artificial intelligence – a Kubrickian computer that blends the human sensitivity of the best old-fashioned gamblers with the brute force of a supercomputer. If that day ever comes, traditional horse bettors may really have something to worry about. ■ ■ ■



THE SENTINEL

OUR ENEMIES ARE THREATENING TO CRASH WALL STREET SERVERS, CRACK IRS DATABASES, AND ATTACK THE NATION'S ELECTRICAL GRID. RICHARD CLARKE IS BRACING FOR THE FIGHT.

A TOUGH TALK WITH THE WHITE HOUSE'S DOOMSAYING, EVANGELIZING CYBERSECURITY CZAR.

By Declan McCullagh

Photographs by Justine Parsons

> "I became the guy you gave the really messy issue to," says Clarke, "whether that was UN peacekeeping or Haiti or building up a chem-bio defense capability."

Even before jets slammed into buildings, Richard Clarke was known in Washington for his dark warnings about anthrax attacks and al Qaeda devilry. In a 30-year career that has taken him from the Pentagon to the State Department and then to the White House, his blunt cautions have made him one of Washington's better-known – and most controversial – doomsayers. Now he's a lookout with a megaphone. On October 9, President Bush appointed Clarke special adviser to the president on cyberspace security and, 10 days later, chair of the new Critical Infrastructure Protection Board. That gives Clarke responsibility for network safety in three areas – the private sector, nondefense government systems, and national security.

These are broad titles with fuzzy duties, and it's not clear how effective Clarke can be: He's the Net equivalent of the national drug czar, a glorified go-between with a small staff and no operational powers. But he does have the authority of the White House behind him. And in a time when all the mechanisms of Washington are calibrated for sensing emergencies, Clarke's role as a defensive coordinator – reporting to national security adviser Condoleezza Rice and homeland security head Tom Ridge – has some force.

His mandate is to reduce risks to the country's technological life-support systems. As more and more of the nation's critical infrastructure – a term that includes telecommunications, power, gas, water, and transportation – is tied to the Net, vulnerabilities multiply. The threat of a terrorist attack is not merely that Web sites could fall offline or email could get zapped. With so many vital services susceptible to cracker tools and techniques, Clarke's world is one in which an al Qaeda member or a hostile nation could snarl the IRS's taxpayer database. Or snatch business secrets through a cunning Microsoft Outlook worm. Or flip the switch on New York City, disabling "electrical power grids and telephones as surely as if they had been destroyed," Clarke has warned.

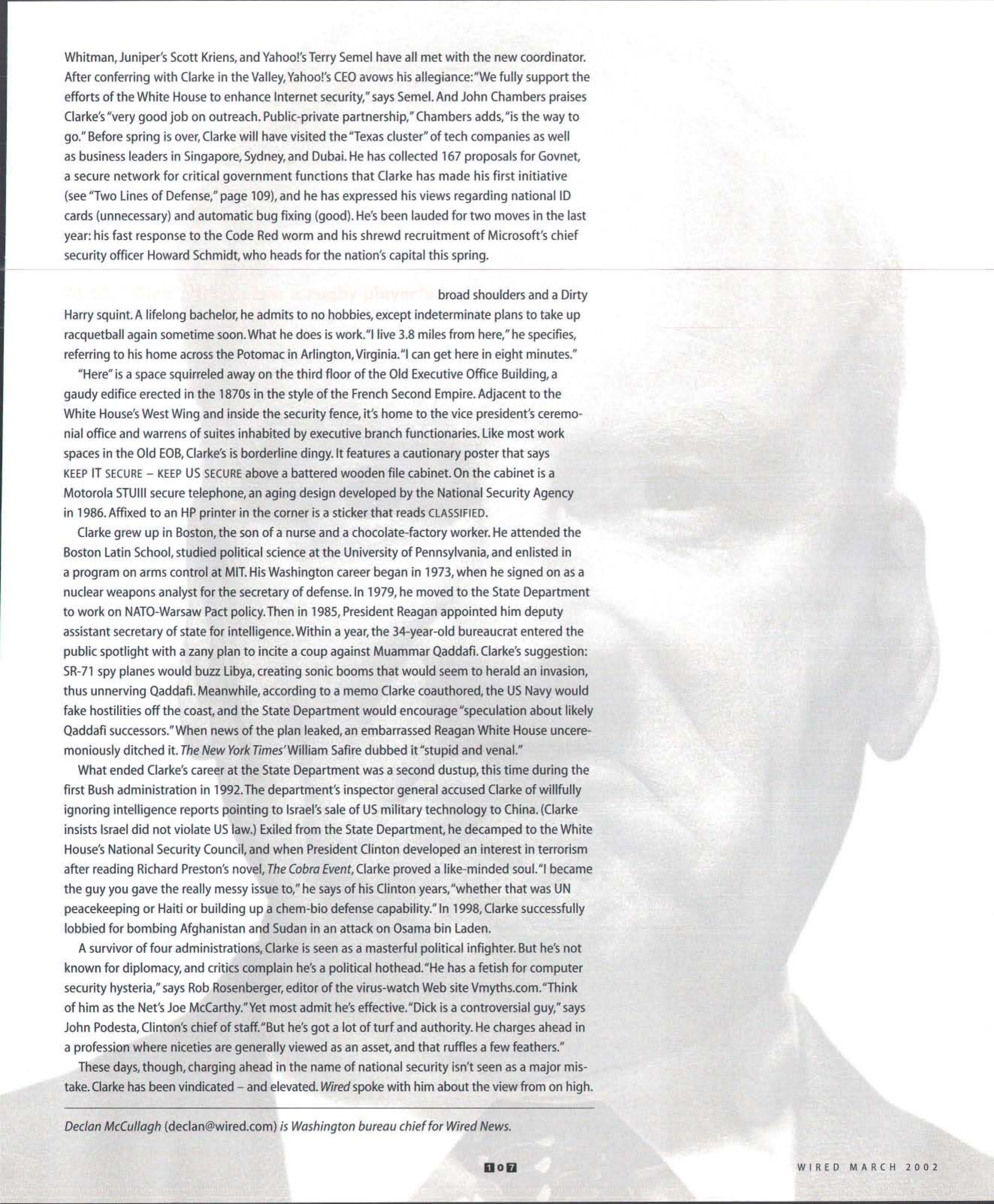
"We do have enemies," Clarke says, seated in his office, behind double-locked vaulted doors in the Old Executive Office Building, "and they're smart. We're a fragile society in many ways, and the worst-case scenario can happen."

To protect critical infrastructure, then, will require that the new czar consider everything from stomping out worms to installing the latest patches on Apache Web servers, from reshaping technical protocols to upgrading the security of the Internet's root servers. All that as the Net continues to grow, offering millions of entry points and thousands of exploitable vulnerabilities, and as hackers have more to work with than ever: Microsoft's slipshod Windows security, automated hacking tools, and all sorts of malicious bits of programming, like Nimda and the Melissa virus. Between 2000 and 2001, the CERT Coordination Center, which is the acknowledged authority on network breaches, reports that known computer security incidents more than doubled from 21,800 to 52,700. Code Red alone infected the US Treasury Department's Financial Management Service, forced the Defense Department to temporarily pull the plug on its Web sites, and interrupted service to Qwest customers. Even a top official at Microsoft, CTO Craig Mundie, who has been meeting with Clarke for three years, concedes that there's work to do: "We think there are fundamental improvements in how you can achieve more trust in the systems."

But while Clarke's worries are rife, his arsenal is limited. Since the Office of Cyberspace Security has no budget of its own beyond salaries and overhead, he must go to other organizations to fund projects. As of January, he had just a half-dozen people on his staff, with a plan to increase that number to about 20. His most public speech so far was at the Business Software Alliance's annual gathering in Washington, DC, an important event for lobbyists but hardly a way to catapult Clarke into prominence.

He's also facing an enormous obstacle in the tangle of existing government bodies already charged with handling network security. After the term *critical infrastructure* became trendy in the late 1990s, new agencies began to sprout at an astonishing rate. Any list would include at least the Commerce Department's Critical Infrastructure Assurance Office, the Defense Department's Critical Infrastructure Protection Directorate, the FBI's National Infrastructure Protection Center, and the Federal Computer Incident Response Center. In a report published soon after September 11, analysts at the General Accounting Office, the investigative arm of Congress, bemoaned the lack of coordination among these entities – a problem that's now Clarke's to fix.

But being close to the president gives him clout. So far, Clarke has had sit-downs with a slew of executives, each of whom alone has more power over cyberspace than does any new-and-improved acronym in Washington. Cisco's John Chambers, Sun's Scott McNealy, eBay's Meg



Whitman, Juniper's Scott Kriens, and Yahoo!'s Terry Semel have all met with the new coordinator. After conferring with Clarke in the Valley, Yahoo!'s CEO avows his allegiance: "We fully support the efforts of the White House to enhance Internet security," says Semel. And John Chambers praises Clarke's "very good job on outreach. Public-private partnership," Chambers adds, "is the way to go." Before spring is over, Clarke will have visited the "Texas cluster" of tech companies as well as business leaders in Singapore, Sydney, and Dubai. He has collected 167 proposals for Govnet, a secure network for critical government functions that Clarke has made his first initiative (see "Two Lines of Defense," page 109), and he has expressed his views regarding national ID cards (unnecessary) and automatic bug fixing (good). He's been lauded for two moves in the last year: his fast response to the Code Red worm and his shrewd recruitment of Microsoft's chief security officer Howard Schmidt, who heads for the nation's capital this spring.

At 50, Clarke has a rugby player's broad shoulders and a Dirty Harry squint. A lifelong bachelor, he admits to no hobbies, except indeterminate plans to take up racquetball again sometime soon. What he does is work. "I live 3.8 miles from here," he specifies, referring to his home across the Potomac in Arlington, Virginia. "I can get here in eight minutes."

"Here" is a space squirreled away on the third floor of the Old Executive Office Building, a gaudy edifice erected in the 1870s in the style of the French Second Empire. Adjacent to the White House's West Wing and inside the security fence, it's home to the vice president's ceremonial office and warrens of suites inhabited by executive branch functionaries. Like most work spaces in the Old EOB, Clarke's is borderline dingy. It features a cautionary poster that says KEEP IT SECURE – KEEP US SECURE above a battered wooden file cabinet. On the cabinet is a Motorola STUIII secure telephone, an aging design developed by the National Security Agency in 1986. Affixed to an HP printer in the corner is a sticker that reads CLASSIFIED.

Clarke grew up in Boston, the son of a nurse and a chocolate-factory worker. He attended the Boston Latin School, studied political science at the University of Pennsylvania, and enlisted in a program on arms control at MIT. His Washington career began in 1973, when he signed on as a nuclear weapons analyst for the secretary of defense. In 1979, he moved to the State Department to work on NATO-Warsaw Pact policy. Then in 1985, President Reagan appointed him deputy assistant secretary of state for intelligence. Within a year, the 34-year-old bureaucrat entered the public spotlight with a zany plan to incite a coup against Muammar Qaddafi. Clarke's suggestion: SR-71 spy planes would buzz Libya, creating sonic booms that would seem to herald an invasion, thus unnerving Qaddafi. Meanwhile, according to a memo Clarke coauthored, the US Navy would fake hostilities off the coast, and the State Department would encourage "speculation about likely Qaddafi successors." When news of the plan leaked, an embarrassed Reagan White House unceremoniously ditched it. *The New York Times'* William Safire dubbed it "stupid and venal."

What ended Clarke's career at the State Department was a second dustup, this time during the first Bush administration in 1992. The department's inspector general accused Clarke of willfully ignoring intelligence reports pointing to Israel's sale of US military technology to China. (Clarke insists Israel did not violate US law.) Exiled from the State Department, he decamped to the White House's National Security Council, and when President Clinton developed an interest in terrorism after reading Richard Preston's novel, *The Cobra Event*, Clarke proved a like-minded soul. "I became the guy you gave the really messy issue to," he says of his Clinton years, "whether that was UN peacekeeping or Haiti or building up a chem-bio defense capability." In 1998, Clarke successfully lobbied for bombing Afghanistan and Sudan in an attack on Osama bin Laden.

A survivor of four administrations, Clarke is seen as a masterful political infighter. But he's not known for diplomacy, and critics complain he's a political hothead. "He has a fetish for computer security hysteria," says Rob Rosenberger, editor of the virus-watch Web site Vmyths.com. "Think of him as the Net's Joe McCarthy." Yet most admit he's effective. "Dick is a controversial guy," says John Podesta, Clinton's chief of staff. "But he's got a lot of turf and authority. He charges ahead in a profession where niceties are generally viewed as an asset, and that ruffles a few feathers."

These days, though, charging ahead in the name of national security isn't seen as a major mistake. Clarke has been vindicated – and elevated. *Wired* spoke with him about the view from on high.

Declan McCullagh (declan@wired.com) *is Washington bureau chief for Wired News.*

> “CEOs need to understand two things:
> 1) You have to have a multilayered defence.
> 2) You can't buy a security product and say you're done – you have to worry every day.”

Wired: You come from the heart of Washington. Are geeks in the private sector listening to you?

Clarke: In many discussions there's a credibility problem. The technical people assume I'm just a policy guy from the White House; they know I'm not a computer engineer. But what happens about 20 minutes into most meetings is I've proven that I know at least as much as they do about a lot of technical things, and in some cases I know things they don't.

Like what?

Well, if I'm talking to a bank or an insurance company or an electric power company, I know a lot more about what security capabilities are on offer, because I've been to so many of the IT companies. My staff acts as a sort of bee, going from flower to flower, doing a lot of cross-pollination that, oddly enough, doesn't naturally occur, despite all of the conferences and advertisements. I can say, “Your problem can be solved by using this application or that application from this company or that company; I don't endorse particular companies, but I suggest you look at their technologies.”

And CEOs – how do you get their attention?

If you're from the White House and you're the president's adviser and you call up a CEO and say, “I want to speak with you,” you get in. What has changed since September 11 is that you're also more likely to get executives to *act*. In the past, they would say, “That's all very nice and we support your endeavors,” but they would do little in terms of their own bottom line. They'd think, “I have a firewall, I have an intrusion detection system, I have antivirus software – I must be safe.” But they have to understand two things: One, there is no silver bullet; you have to have a multilayered defense. And two, you can't buy a product and say you're done – you have to worry every day. Right now, about 60 percent of my time is spent on the private sector.

So is your job just to proselytize?

We have lots of different ways of getting our message across. One is pure bully pulpit – the power of the White House convening authority, it might be called. When we have conferences at the White House, people tend to come. But we also have procurement authority, so that if there's a piece of software or hardware, a carrier or an ISP that we approve of, we may decide that the federal government – which in almost all areas is the largest procurement source in the country – will only buy products that live up to those standards.

You've got to be Microsoft's largest customer.

Yes.

What happens when you take the bully pulpit to Redmond?

Over the past year, there has been a healthy dialog among myself, Microsoft, the Defense Department, and the intelligence agencies – which use Microsoft products – about the standards we want in what we buy from them. I have to emphasize that this discussion was an entirely different channel than the antitrust case.

Does Microsoft's software live up to your security standards?

We think XP is somewhat better than previous versions of Windows. And we believe the next generation will be spectacularly better – at least if what we're discussing with them is included.

What are you asking for – a change of defaults or more actual security precautions in the code?

Both. And also the steps you take so that the development process itself is more secure and there's adequate advanced testing before a product goes to market. Microsoft developers also need to build in security as the default setting. They need to have the operating system do some of the work that security applications did heretofore. And they need to have a system that, when they do have patches – and they inevitably will – gets the fixes out quickly and reliably and gets people to use them. (See “Automatic System Repair.”)

The National Security Agency has a Secure Linux Initiative. What do you think of that?

There is no one in the federal government who dictates software for all agencies. We have chosen not to do that. In effect, we've let a thousand flowers bloom. And the result is Solaris, Trusted Solaris; varieties of Unix, including Linux; and Microsoft. And we have to be able to support all of those and make sure they are all as secure as possible.

Given the fact that there were federal agencies running Linux, it seemed to us only natural that the responsible thing to do was to ask NSA to make it more secure for the agencies running it. I know Microsoft objected, but I think it was the right decision.

So there's evangelism, procurement – how else can you use your position to prevent disasters?

We can fund research where the market doesn't, and we're doing so now. We can share information. We have an awful lot of information about

A SUPERSECURE INTERNET

Among the initiatives Richard Clarke is pursuing is the creation of a separate-but-better Internet that would be immune from security attacks. Dubbed Govnet, it would have no connections to public phone systems, traditional ISPs, or the current network backbones. In an age when federal agencies rely so much on the Net that a single disruption could halt the business of government, Clarke's plan has drawn support from numerous jittery officials.

It's not an idea original to Clarke. The Pentagon and the NSA already use an independent system known as JWICS, the Joint Worldwide Intelligence Communications System, which supports T1; carries data, voice, and video; and is approved to handle information at any level of classification. And the military uses a host of communications networks, some for tactical communications, some packet-switched, some top secret and some not. But Clarke argues that a separate Govnet is necessary for redundancy, and 167 tech companies – including Sun and Sprint – have responded to Clarke's request for possible designs.

Critics of Govnet, meanwhile, point to the huge cost of building a dedicated network and to the temptations of users – even at the highest levels of government – to transfer files via floppy, or move their laptops, between Govnet and public networks, thus compromising the supposedly hermetic system. Fiercer critics say Govnet's just another wasted effort, borne of Clarke's fears of a "digital Pearl Harbor," which has never come to pass.

TWO LINES OF DEFENSE

AUTOMATIC SYSTEM REPAIR

Gabriel Rocha is not normally a religious man, but he "swears to God" he'll never let anyone perform remote security repairs on his computer. The former systems administrator fears that patches installed automatically by vendors might create new vulnerabilities or crash important programs – in other words, trigger the law of unforeseen consequences. "What happens," asks Rocha, currently a security consultant in Geneva, "when they fuck up the patch?"

That's a prime question for Richard Clarke, who has proposed that software companies try harder to plug security breaches for customers, even if that means doing it for them. For someone like Clarke, who's paid to be paranoid, the idea of millions of users trusting their secrets to bug-riddled versions of Windows is a nightmare. Especially, that is, when fixes are available and need only be installed. "There's a technological problem that I don't think is beyond the wit of man to solve," says Clarke, "and it's the following: When they get patches now, systems administrators don't apply them."

His solution? Send out the digital equivalent of flu shots, which inoculate machines against malicious code – and send them out automatically.

Redmond is willing to go along. CTO Craig Mundie says Microsoft is working on both increasing security during the design stages and building a system that will "automatically apply patches as new vulnerabilities surface." Of course, auto-updating gets you nowhere if it's not enabled: In December, Microsoft admitted that Windows XP included a vulnerability and sent out a patch, but since XP's auto-update feature is turned off by default, relatively few users benefited.

Most security experts agree that spontaneously delivered fixes are a must for home users, who aren't known for perusing security newsletters warning of the latest perils. But managers who oversee hundreds of machines don't trust the remedy – with good reason. When Microsoft released Windows NT 4.0 Service Pack 6, a collection of fixes for the OS that was guaranteed to be worry-free, it ended up wreaking havoc for Lotus Notes users; a chastened Redmond security team had to create Service Pack 6a. And in the Unix world as well, auto updates pose dangers: Sun's Solaris patches can mess with third-party email software, or worse, savvy attackers can sabotage the updates and insert backdoors.

But Clarke isn't deterred: "I know systems have lots of applications running, but it should be possible to securely deliver, with authentication, a patch, accompanied by a diagnostic that says, 'If you apply this, the following programs will be impacted in the following way.'"

Good. Next step? Persuade sysadmins like Gabriel Rocha to use it. – *Declan McCullagh* vulnerability to attacks and patterns of attacks and those kinds of things. We can also facilitate private sector entities sharing information with one another.

> “Most Fortune 500 companies spent .0025 percent of revenue on IT security – less than on coffee. Now, if you spent .0025 percent, you deserve to be hacked. And by the way, you will be.”

Do you need more authority? Do you need laws that say, “These are the standards everyone has to meet”?

On the government systems side, we already have a lot of authority to issue standards and enforce them – we've never done that. And when people say we have no power because we have no control over budgets – guess what? We have control over budgets. For the first time ever, in December, the White House sent back two federal departments' budgets, saying, “Excuse me, you have a known and documented IT security problem, and you haven't budgeted for its remediation, so we're taking money out of other programs you wanted to fund and applying it to IT.”

Now, that won't seem like a big deal to most of the public, but within the executive branch that is an 8.4 Richter-scale earthquake. We're going to practice what we preach. We're going to increase IT security.

How will you handle all these functions with a staff of two dozen people?

Let me give you a quick sketch. We'll have three clusters of people working in three areas – government systems, the private sector, and national security. Our philosophy is not to create a new agency and not to absolve the federal departments of their responsibilities. Neither Governor Ridge, nor Condi Rice, nor I in cyberspace run operating agencies. We rely upon the departments and the agencies to do the work, and that's important, because there is a tendency in bureaucracy for people to wash their hands of an issue if you take away responsibility. That happened several years ago, when the drug czar was created. A lot of agencies said, “I don't have to worry about that; the drug czar will do it,” and we learned from that. We don't want to hear, “Oh, the cyberguy in the White House will worry about that.” Our whole structure and design is meant to push down accountability and responsibility to the agencies, and that's new, because they have never really been held accountable for their IT security.

So how do you actually mobilize all this bureaucracy in the event of a crisis?

Let me give you an example. In July 2001, when the Code Red virus appeared, various people in the private sector got the code for it and, working with people in the government, created a virtual team to analyze it quickly.

Who was on that team?

Some antivirus software companies, like Symantec, along with the NSA, the CIA, the FBI's National Infrastructure Protection Centers, and others.

Is this a standing team?

We're trying to build a structure that would link up various entities in the private sector so that in a given crisis, like Code Red or Nimda, we would get the right people talking to each other. This response network, the Cyber Intelligence Warning Network, would provide out-of-band connectivity that's initially voice but then voice and data.

In the case of Code Red, everybody together did things a lot quicker than people would have done if they had been stovepiped, just doing it by themselves. It was a real effort at information fusion, the result of which was that we realized, around four o'clock in the afternoon, that there was going to be an enormous denial-of-service attack on Whitehouse.gov. And although I was perfectly willing – and Andy Card, the chief of staff, was perfectly willing – to take the White House Web site off the air for a while, we were unwilling to have the tsunami of the denial-of-service attack moving down the backbone, because it would pop routers and knock people off the air.

What we were able to do, using this response mechanism, was to get to the five or six major backbone providers and say to them, “Hello, this is the White House. We would like you to block all traffic to the White House.” After they got over the initial shock, saying, “Who are you really?” – we would say, “Call us back at the White House at 456-1414” – we got them to block all White House traffic at the end routers. So when eight o'clock came along and all of these little zombie-ized computers that had been attacked by Code Red fired up to do their denial-of-service attack, their messages got about as far as the end routers and died.

Didn't you simply assign Whitehouse.gov another IP address?

We did a couple of things. The most important was blocking the IP address that was in the code at the edge router, because, whether or not we changed our IP address, that attack was still coming and would have floated down the backbone all along the way. The other thing we did was change the IP address and DNS tables. This was so that the DNS tables and the Border Gateway Protocol messages, which were looking for

Whitehouse.gov, would also find out it's not this IP address, it's this one.

How does that kind of team communicate?
Until we get a formal network running, it's a little ad hoc. We have videoconferencing capability for the government agencies, and we try to either bring the private sector people into a government site, where they can connect to that network, or bring them in via voice. Ideally, we'll have a network where we can throw Cisco up on one screen and the FBI's office for infrastructure protection on the next screen.

Where?
In the West Wing. The situation room.

In December, a Portuguese newspaper reported that a PGP encryption manual was found at one of the Taliban's safe houses in Afghanistan. Should cryptography be regulated?
We went through the agony of decisionmaking about encryption in the late 1990s. We tried a few things, like Clipper Chip, and that didn't work. But we've got a fairly decent policy right now, which doesn't explicitly articulate a standard of what can and cannot be exported. It merely says that if you're going to export something, you need to give it to us for review first so we understand what's going to be out there. And I think this is working. We just have to realize we're living in a world where bad guys are going to get encryption, and there's nothing we can do from a policy perspective that's going to stop this.

Is this your position or the administration's?
It's the administration's position that we don't need to change our current encryption policy and that the decision made two years ago seems to be working. We're perfectly willing to review it from time to time, but we don't think that there's any reason right now to change it.

And what about creating backdoors for law enforcement?
If a law enforcement agency knows about a vulnerability, so does everybody else. We're only kidding ourselves if we think we have some special advance knowledge that is not being discussed in IRC chat rooms. If we know about it, others will know about it, and they will use it for criminal purposes and destructive purposes. Whenever you face a choice about offense versus defense, your first obligation has to be to defend the private sector, the taxpayers.

You're espousing the full-disclosure model, but Microsoft and others want limited disclosure.
My view is that if you know about a vulnerability, your obligation is to report it to the software manufacturer in the first instance. You also ought to report it to the federal government, either to CERT or to the FBI's NIPC, but you definitely have to report it to the software manufacturer. If they then don't do anything about it, I think you need to turn up the heat. And in part, I would recommend that you turn up the heat by working with us, working with CERT, working with NIPC; we might have a little bit more ability to increase the heat.

Explain how you went from being a State Department bureaucrat to talking with techies about bug fixing.
I never did traditional State Department work. I did arms control, technology policy issues. And then, when the Soviet Union invaded Afghanistan in '79, arms control sort of went on ice for a while, and I became a crisis manager. That didn't involve technology, but it did involve coordinating lots of different organizations inside and outside the government – what now is called herding cats. Later, after Oklahoma City was attacked, we tried to sit back and understand its implications. One thing we saw was that we should have a presidential commission look at our vulnerability domestically. That evolved into looking at vulnerabilities in our IT and telecom infrastructure.

OK, so now imagine you've got a bullhorn aimed at Silicon Valley – what do you want to say?
Spend money on IT security. The Forrester Group did a survey of how much people were spending on IT security in 2000, and their estimate was that most Fortune 500 companies were spending .0025 percent of revenue. Now, if you spent .0025 – and incidentally, those companies spend more than that on coffee – you deserve to be hacked. And by the way, you will be.

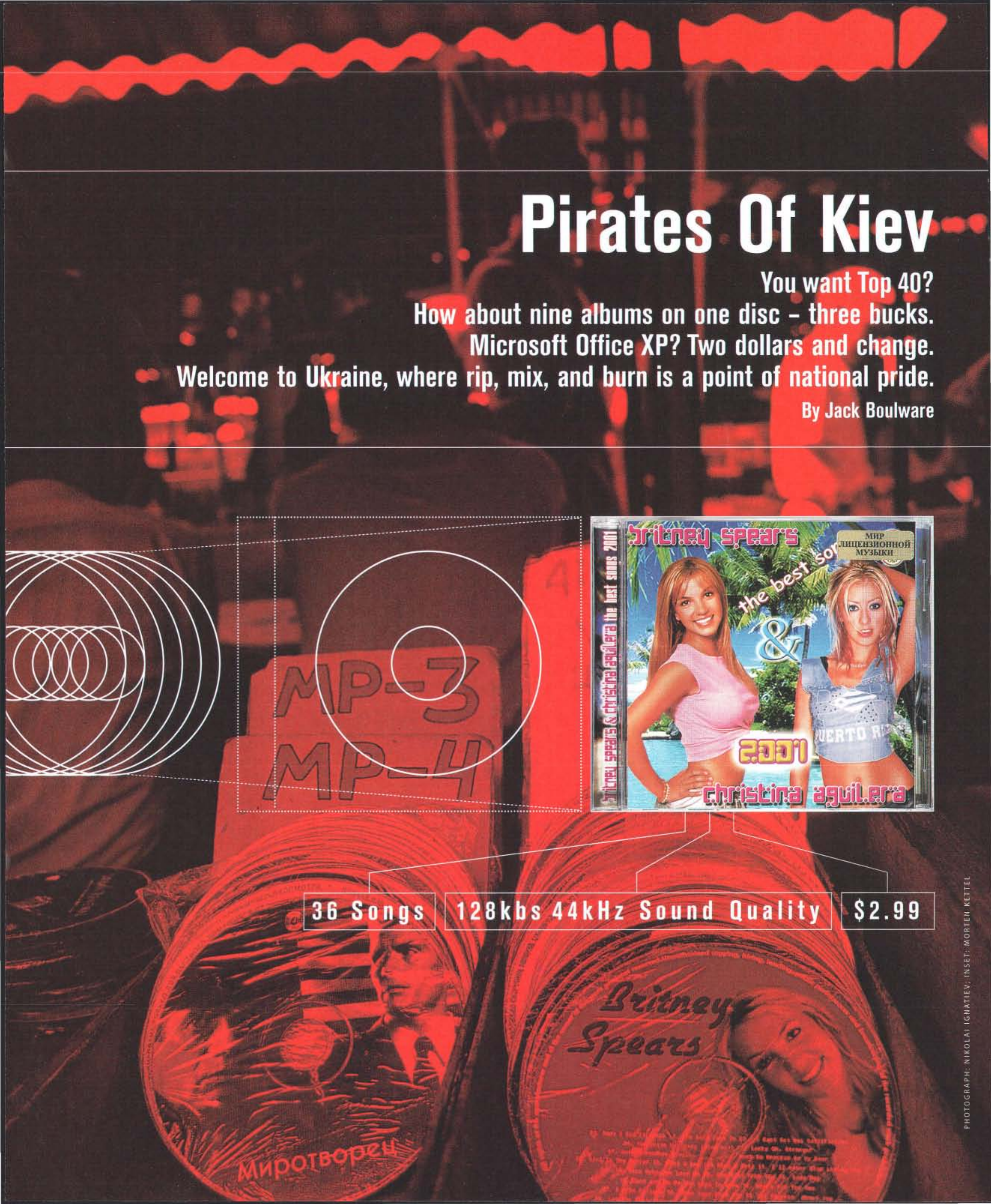
People don't know how much capital information technology should require. It was such a godsend in terms of production costs in every industry that, implicitly, decisionmakers began to equate IT with cost reduction. The fact is companies reduced costs too much. They never adequately invested. Information technology has got to be an ongoing cost, not a one-shot deal, for outsourced or in-house management, or both.

Otherwise?
Frankly, until government and the private sector start spending more, we won't get security. ■ ■ ■

Pirates Of Kiev

You want Top 40?
How about nine albums on one disc – three bucks.
Microsoft Office XP? Two dollars and change.
Welcome to Ukraine, where rip, mix, and burn is a point of national pride.

By Jack Boulware



PHOTOGRAPH: NIKOLAI IGNATIEV; INSET: MORTEN KETTEL

In a sprawling outdoor market in northern Kiev, teenagers are setting up booth after booth, each stocked with illicit CDs. The police raided this market the previous day, but you wouldn't know it from the inventory being rolled out. Within minutes, some 40 stalls are overflowing with audio CDs, CD-ROMs, DVDs, and videocassettes priced from 2 to 15 hryvnia, roughly 40 cents to $3. Music by the Beatles, Britney Spears, Madonna, and Oasis is stacked alongside the latest Hollywood movies and desktop applications. Some feature a gold sticker that brazenly proclaims: THE WORLD OF LICENSED MUSIC.

A Metallica disc catches my eye. It's a compilation, but not your typical greatest hits collection. It's *nine* of the group's albums crammed onto a single disc, thanks to the marvel of MP3 data compression – a 122-track cavalcade of thundering heavy metal memories. Price: $3.

For the average legitimate US release sold in Ukraine, that wouldn't even cover royalties due the artist, song publisher, and record company. This Metallica disc might be worth more than $27 in royalties alone.

When I gesture to the young man running the stall that I'd like to make a purchase, the transaction immediately takes on the quality of a drug deal. The clerk walks me across the street to another stall, where a salesman whips out a calculator and punches a few keys. A third clerk takes my money and holds a bill up to the sun to make sure it's not counterfeit. As an old Russian saying goes, cheat or be cheated.

Street markets like this one account for the bulk of software sales in this former Soviet republic, but local business is just the beginning. Ukraine is one of Europe's largest sources of unauthorized discs, cranking out as many as 70 million units each year, most of them for export. Ninety-five percent of music CDs shipped from Ukraine are produced illegally, according to the International Federation of the Phonographic Industry (IFPI). A tally of Ukraine's impact on the movie industry isn't available, but the Motion Picture Association of America estimates that neighboring Russia accounted for $250 million worth of DVD and video piracy in 2000. Even if these numbers are inflated, there's no doubt that Ukraine does a brisk business in liberated intellectual property.

Since much of this property lawfully belongs to American companies, the US government has tried repeatedly to stanch the flow of pirate discs. Each time, the Ukrainian administration has done just enough to give the appearance of cooperation, without actually delivering. In 1999, President Clinton strong-armed Ukrainian president Leonid Kuchma into promising that his country would pass legislation to shut down the pirates. The legislation never materialized, but in June 2000, Kuchma agreed to the US-Ukraine Joint Action Plan to Combat Optical Media Piracy, a pledge that police would crack down on pirates and that Ukraine's legislature would codify intellectual property rights for optical media. Still, nothing happened. In November, a bill designed to stymie disc pirates failed to pass the Ukrainian Parliament. Less than half the legislators even showed up to vote. Tired of waiting, the US this past August suspended Ukraine's duty-free status for a wide range of exports and set a deadline of December 12 for the nation to outlaw optical-media piracy. When that ultimatum went unheeded, the US followed through with trade sanctions worth $75 million a year.

Ukraine's piracy wouldn't be possible without government complicity, or at least complacency. The country's five CD factories have been among its most lucrative private businesses, and few officials have had the stomach to challenge them – not to mention their shadowy organized-crime customers. Moreover, the factories employ a network of lobbyists that would make the NRA proud. Over the years, they've managed to exploit Ukraine's unstable political environment to derail antipiracy legislation time and again.

"The guys who own the CD plants know how the political system works in Ukraine," says Jay Berman, CEO of the pirate-busting IFPI, which represents producers and distributors in 76 countries. "They say, 'Hey, we've got a successful business. What are you guys yelling about?'"

As Igor Eichenwald, a lobbyist for the CD manufacturers, matter-of-factly told the Ukrainian press last September, "If the law [criminalizing piracy] is adopted, the enterprises involved in optical-disc production will either curtail their activities or ignore its requirements."

Ukraine's CD makers portray themselves as Robin Hood figures, protecting their country's consumers from high prices set by the avaricious US music and software industries. The average wage earner, who makes $100 a month, has every incentive to agree. "Customers know their CDs may be pirated, but if that changes, they'll have to pay more," says a US official stationed in Kiev. "So no change is good."

Globalization is bound to bring US business practices into conflict with local attitudes, but the notion of intellectual property may prove to be one of the most difficult to reconcile. Here, piracy is practically a point of national pride. In the outdoor market in Kiev, I come across a copy of Microsoft Office XP selling for the equivalent of $2.20 – not bad for a program that costs $580 in the States. I hold up the disc and ask the clerk, "Where was this made?" Bursting with patriotism, he replies, "Here, in Kiev!"

The Rostok CD factory, situated in a tree-lined district of Kiev, looks like an old steel mill that has seen better days. Owned by Rostok Corp., a large electronics conglomerate, the plant produced missile parts during the Cold War and began cranking out optical discs in 1995.

Ukraine has its share of small-time pirates who produce CD-R knockoffs, usually distributed in flimsy packaging rife with misspellings. But more than 90 percent of Ukraine's unauthorized output comes from big-time operations that make their own polycarbonate discs. These plants produce picture-perfect copies of legit products, painstakingly reproducing inserts and promotional stickers. A Ukraine-manufactured Whitney Houston greatest hits package, for instance, includes a lavish four-color booklet complete with fan club mail-in card. Some titles even display the pirates' own logos as a mark of quality.

Ninety percent of Ukraine's pirate output comes from big producers that make their own polycarbonate discs; some use their own logo as a mark of quality.

Rostok's lobby looks like the reception area of a US record company. The walls are festooned with framed CD covers and posters signed "Thanks Rostok" by local musicians. Yet there's a self-conscious quality to the display, as though everything has been arranged in a deliberate effort to create an aura of legitimacy. The receptionist bristles when a photographer reaches for his camera.

"You need permission to take pictures," she says. "It's private property. We're under fire from the Americans."

The US-Ukraine Joint Action Plan compelled Rostok and its sister factories to submit to inspections by officials from the American and European music industries. Early efforts yielded nothing, according to *Kiev Business*, a magazine sympathetic to the CD plants. During one such foray, the publication reports, a record industry representative sidled up to an employee and asked, "What are you producing?"

"Optical-media products," the worker replied.

"Which?" said the official.

"Those that can be manufactured on this equipment!"

The inspectors left without finding a single unauthorized disc.

But just a few months later, they were back – and this time, they hit paydirt. An investigation this past May turned up "substantial evidence of involvement with pirate production," according to IFPI spokesperson Adrian Strain, as confirmed by the organization's forensic lab.

Nonsense, insists Rostok director Oleg Purik. He's just an honest Ukrainian businessman, struggling to compete with the US colossus.

"America is a powerful country able to solve its internal problems at the expense of other countries," Purik told *Kiev Business*. "Although plants that manufacture cheap CDs can be found in China, Russia, Bulgaria, and Taiwan, sanctions are planned only against Ukraine. The USA just needs boys to beat up. It's a pity that our country can't offer any resistance."

But, in fact, US authorities have forced pirates in China and Bulgaria to walk the plank, thanks to the IFPI. From offices that overlook the mad rush of London's Piccadilly Circus, the organization acts as a worldwide clearinghouse for piracy information. The IFPI's investigative division compiles a database of pirate activity – from sightings of illicit products to stats on seizures – accessible to law enforcement worldwide. A forensic lab scans confiscated discs for telltale surface nicks that can reveal where a given item was manufactured. The IFPI passes this information along to the US Embassy in Kiev, which alerts the Ukrainian government. As the IFPI fingers pirates, the United States Trade Representative stands by, ready to lower the sanction boom.

Rooting out Ukrainian piracy won't be easy, IFPI representatives admit. "The problem is definitely not yet resolved," says Adrian Strain, displaying the British flair for understatement. "Fighting piracy tends to be a long haul in countries like Ukraine, where the laws are inadequate and awareness of intellectual property is low."

Once the discs have been manufactured, pirates have no problem shipping them around the globe by air, passenger train, boat, and, in at least one case, an airtight underwater barge towed by a ship, according to IFPI reports. The easiest method is simply to truck them into one of the member countries of the European Union. Inside the EU, the vehicles roam free of customs searches.

"We seized one recent shipment of 25,000 CDs, ferried into the UK in a

---

Jack Boulware wrote about car stereo wars in Wired *8.10.*

PHOTOGRAPH: NIKOLAI IGNATIEV

The battle against piracy is a bit like the war on drugs.
It hasn't worked.
Counterfeit CDs are hitting streets
even before the legitimate versions are released.

station wagon," says David Martin, antipiracy director for the British Phonographic Industry. "The CDs were shipped on spindles, 175 on each. In a station wagon, you can carry 10,000 like that easily. They did the stickers as well. These are the best we've ever seen." In this case, BPI and IFPI investigators tracked down distributors in Belgium, Holland, and the Czech Republic, eventually tracing the trail back to Ukraine.

The Ukrainian end of such operations looks relatively conventional by small-business standards, and Rostok hasn't been accused of anything more nefarious than piracy. But the networks that distribute unauthorized discs are often run by international syndicates, investigators say. "Russian organized crime is definitely involved in music and software piracy," says Rich LaMagna, Microsoft's senior manager for worldwide antipiracy investigations. "If these people were in the drug business, they would be the Cali cartel."

Indeed, the battle against piracy is a bit like the war on drugs – it's imperfectly measured in arrests and seizures, and no one is quite sure who's winning. In fact, Iain Grant, chief investigator for IFPI's antipiracy effort, worked for years as an international narcotics cop. "There are obvious similarities between drugs and pirating – the methodology, often the financing," he says. "I've come across individuals in international music piracy who were already familiar to me from my previous existence in drug enforcement."

Some see even darker forces at work. "In a number of instances," says Neil Turkewitz, an international relations specialist with the Recording Industry Association of America, "the syndicates we know of are connected to terrorist organizations."

The Ukrainian government is a democracy, but it's also an antiquated bureaucratic labyrinth of Soviet-era laws, woefully understaffed courts, and bribe-taking police. The authorities have their hands full with the basic issues of nurturing a viable body politic. The futility of expecting them to squelch media piracy is almost comically apparent during a meeting between the Ukrainian Music Alliance and Sergiy Lebid, a police officer from the Department of Intellectual Property Protection. The alliance, made up of Kiev-based distributors and record companies, forms the backbone of Ukraine's beleaguered legitimate music industry. Finding their businesses untenable in the current climate, the entrepreneurs have appealed to the ministry for assistance.

The meeting convenes amid unopened boxes of CDs in the office of Ukrainian Records, a licensing outlet for Universal Music. A translator interprets the conversation for the benefit of non-Russian speaking visitors. Even though everyone is sweating like they're in a spaghetti western, they're all dressed in slacks and black leather shoes. In the old days, there might have been a portrait of Stalin on the wall. Instead, hanging above our heads is a huge poster of Eminem.

A Kiev record producer named Valerie expresses the group's frustration: "The situation is an outrage!" The alliance can't depend on the police to put the pirates out of business, so they've pooled funds for a part-time attorney to accelerate prosecutions. It hasn't worked. Pirate CDs are hitting streets even before the legitimate versions are released.

Lebid nods. "Efficiency is very low," he says – his way of admitting that the government's own antipiracy efforts have been ineffectual.

The officer suggests that the alliance give its attorney a bigger role. The group needs a full-time point person in a dedicated office, working the phone, filing claims, and acting as principal contact for government agencies, he explains. The businessmen look irritated, but they remain silent.

Seizing the opportunity to escape, the policeman stands up and announces, "When you've made up your mind, come to us," then bolts for the door.

From the alliance's point of view, the officer's suggestion would only further bankrupt the country's fledgling businesses. Maybe the money spent would result in more legitimate CD sales. Maybe not. Valerie pulls a pack of cigarettes out of his pocket and mutters, "So in other words, I pay money, and then I see sales."

As the entrepreneurs grumble, a government lawyer explains why local police have little impact. It's not just bribery, though that's certainly a problem. In many cases, the judges themselves don't view intellectual property theft as a crime. In fact, the penalty for a piracy conviction – up to 6,800 hryvnia ($1,300) or two years in prison – has never been imposed.

The best solution, the lawyer says, would be to lodge several lawsuits at once, along with a body of evidence that proves significant monetary losses. And that would require a full-time lawyer.

"Let's do it," one producer says sarcastically. "In a couple of months, piracy will end, and it will only cost 100 million!" Everyone laughs with bitter resignation.

As the latest antipiracy bill languishes in Parliament, observers disagree over how many of Ukraine's five CD factories are still in operation. The IFPI reports that two plants have packed up and moved to Belarus, where pressure to put pirates out of business isn't so intense. The news daily *Fakty* says three have closed. Lobbyist Eichenwald puts the number at four.

Shutting down plants, of course, is a long way from changing the mindset of a nation that has spent the past decade nurturing its black-market economy. Even in the wake of broken deals, missed deadlines, and sanctions, officials there seem to think that something less than decisive legislative action will keep the US media and software industries at bay.

"I've seen a lot of progress in recent months," says Sergiy Bondarenko, Ukrainian intellectual property czar, "and now we're really not as guilty as some might think. The results of the recent changes won't appear in one day. We need more time."

Ukraine may yet make the transition from Europe's black-market kingpin to law-abiding citizen of the international business community. But it will take time. Meanwhile, just outside the front door of Bondarenko's office building – the national authority over intellectual property rights – a sidewalk vendor displays his inventory of pirate CDs. ■ ■ ■

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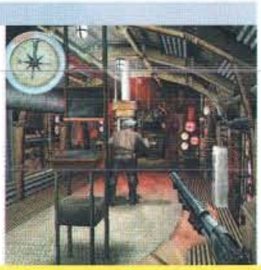


GAME

Medal of Honor Frontline

$50

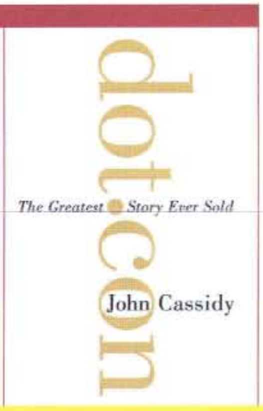
When *Medal of Honor* arrived in 1999, its combination of small-screen accuracy and big-screen glitz set new production standards for videogames. *Medal of Honor Frontline* for PS2 pushes even further, blowing current practices out of the water with 3,000 animation sets and 400 audiofiles. The lush cinematography and sound rival any box office smash, which makes playing *Frontline* like starring in an action movie. In fact, it begins in a deserted French town, much like the one in the final act of *Saving Private Ryan*.

Save your own Private Ryan

Adding to the realistic horror, many of the game's missions are based on World War II events, and developers enlisted a Smithsonian aircraft expert to design the HO-IX, an experimental Nazi plane.

In my role as Lieutenant Jimmy Patterson, I traversed five levels while attempting to infiltrate a German camp and steal the HO-IX. I'm ready for that screen test, Mr. Spielberg. – *Suzanne Ashe*

Electronic Arts: *www.ea.com.*



BOOK

Dot.Con: The Greatest Story Ever Sold, by John Cassidy

$26

Of the many ills afflicting business journalism, here's the worst: Most journalists can't count.

Never was this more apparent than during the new economy boom. Reporters raced to Silicon Valley, but they rarely got the numbers right. The superhighway was a multimillion-dollar dead end; entrepreneurs' paper wealth was left unrealized when stocks crashed long before shares were exercised. It was the bankers and the stock-flippers, not the whiz kids, who got really rich.

But in the pages of *The New Yorker*, writer John Cassidy showed that he could do his sums. As the magazine's economics reporter, Cassidy was a rare skeptical voice as he chronicled the emergence of the Internet stock boom. Many of those stories are gathered in *Dot.Con*, recast and buffered with new supporting material. Cassidy marshals them to argue that the bust was inevitable, the result both of irrational exuberance by investors and quite rational, if myopic, self-interest by Wall Street analysts and fund managers.

While many books chronicle the end of the boom, *Dot.Con* proves to be one of the few that combines an entertaining story with intellectual heft. Towering figures – like Mary Meeker, Jim Cramer, Marc Andreessen, Jeff Bezos, even Alan Greenspan – are laid low by Cassidy's scathing historical framework of the financial bubbles and the attendant stars of the past.

The Net's consummate critic does the math

But the book's title promises too much – Cassidy never delivers the implied smoking gun. Indeed, he is unable to dismiss the most fundamental notion (a mantra among the true believers) that the Internet changes everything. Despite the stock market meltdown, almost any reading of the evolving business practice wrought by the Internet suggests that more dramatic changes are yet to come.

Cassidy tries to cast aside the touchstones of the new economists – his argument says rising productivity, growing markets, and falling prices may, in fact, be more mirage than miracle. When Cassidy started work on this book, he was a rare dissenter. But the subsequent collapse of the technology-driven economy has made this a more popular notion. And yet, by historic standards, productivity is still strong. Prices are still falling. The new economy isn't dead yet. In the end, Cassidy's argument is far from won, but his careful prose and broad perspective help his book go down easy. – *Cory Johnson*

HarperCollins: *www.harpercollins.com.*

WEB

Dictionaraoke

FREE

Redefining sing-alongs

What could possibly make you want to hear "Macarena" again? How about a dictionary that sings pop songs? That's exactly what the pranksters in the Snuggles new media collective accomplished with this Web site. Dictionaraoke replaces original vocals with audioclips from pronunciation guides at online dictionaries.

The site's stylistic variations help it transcend the one-joke conceit. On "(I Got You) I Feel Good," numerous voices chime in, but on "Breakin' the Law," a soloist dominates. And "Don't Go Breaking My Heart" is a romantic duet that pairs *Merriam-Webster OnLine* with Microsoft's *Encarta Online.*

The scholarly overenunciation helps to decipher misheard lyrics. Pink Floyd croons of "dark sarcasm," not "*Dukes of Hazzard,*" in the classroom.

Best of all, the site has complete instructions on how to assemble your own Dictionaraoke tracks so that you, too, can bring in the funk ... *and Wagnalls.* – *Chris Baker*

Dictionaraoke: *www.dictionaraoke.org.*

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MOVIE

Space Station

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Astronaut home movies in Imax 3-D

When I saw my first Imax feature in the 1970s, the Apollo missions were still symbols of the future. Now Imax is taking the genre to a whole new stratosphere with *Space Station*, the first 3-D movie ever shot in orbit.

The 45-minute documentary shows what it's been like to live and work on the International Space Station. It's got all the scenes you'd expect: astronauts outside the station building stuff, astronauts inside the shuttle performing nondescript experiments, astronauts going about their daily business in cool zero-g, and, of course, lots of dockings and undockings.

But like the space race itself, the real story here is the technology. Two cameras were built specifically for this project. The first shooter, the size of a file cabinet, was bolted inside the shuttle's cargo bay, where its three-lens turret offered a creative range never before available to the astronauts-cum-filmmakers. It was remotely controlled via laptop and, because the cartridges couldn't be changed in space, it captured only eight minutes of footage per flight. The second camera is the size of a wall safe. It has removable handgrip controls (attached by a 6-foot cord), a small LCD viewfinder, and changeable magazines that hold 1,200 feet of film, or about 2 minutes of action. And since the radiation in space causes film to fog up over time, all of it had to go up and come down with the shuttle – making it a precious commodity.

Both cameras improve upon older 3-D Imax machines. Each shoots left- and right-eye images on a single strip, unlike terrestrial models that use two synchronized mechanisms. This strip allows for a smaller unit, but requires much faster film-feed speed and specialized parts made of beryllium, a superlight metal that is six times stronger than steel.

Space Station is an alternative to the grainy five-second shots featured on most news programs and gives us something we haven't seen before: the story writ large of the most expensive government housing and science project yet, 220 miles above our heads. – *Stuart Luman*

Imax: *www.imax.com/films/production/space_station.html.*

GAME

Eternal Darkness: Sanity's Requiem

$50

Nintendo goes insane

Easily the creepiest GameCube title on radar, this psychological thriller spans three epochs – classical Roman, medieval, and modern-day. Acting as a tortured soul from the era of your choice, you confront natural, psychological, and supernatural forces, armed with the appropriate weaponry (from nasty maces and broadswords to pump-action shotguns).

At first glance, *Eternal Darkness* bears a superficial resemblance to any number of survival horror games (think *Resident Evil*), but there's a hook here – and it's a bitch. While characters explore ancient stone corridors or modern parlor rooms, battling creatures at every corner, their minds literally begin to go. As a player's sanity (which is represented by a meter) plummets, the graphic environments and interface become hostile.

I took my first such experience to be a software glitch. My character's arms fell off, leaving me with a nightmarish black-clad *Venus de Milo.* Then, her head disappeared and I was commanding a writhing torso in a dark room. I nearly dropped the controller. Moments later, I was whole again. It was just a "hallucination" – a trick of the game. After something like that, how eager was I to casually stroll into the next room? Not very. Playing *Eternal Darkness* just before bedtime is not recommended. – *Chris Hudak*

Nintendo: *www.nintendo.com.*

HARDWARE

Gamma-Scout

$297

Beyond Geiger

Radiation is odorless, colorless, tasteless, and deadly. But it never really worried me – until experts suggested terrorists could add radioactive material to explosives and poison an entire city.

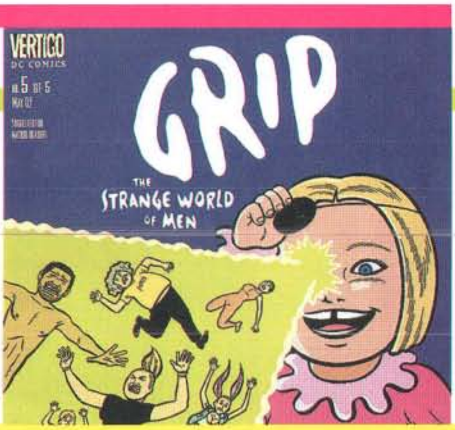
Now I've got the Gamma-Scout, an ultrasensitive radiation meter with a 10-year battery and no Off switch. The portable tells you what's hot and what's not. It also records your accumulated exposure – something traditional Geiger counters can't do – and comes with a serial cable that lets you transfer data to your PC.

Loose nukes aside, I tracked plenty of radiation in my local environs: smoke detectors, dentist's offices, and even Fiesta ware decorated with uranium-based glazes.

With a max reading of 80 microsieverts per hour (four years of exposure at this level and you're toast), the unit won't be useful at ground zero.

The meter lacks a speaker, so there's no audible alarm when levels get dangerous. If we're ever attacked, I'll watch my Gamma-Scout, not CNN.
– Simson Garfinkel

Gamma-Scout: *www.gammascout.com.*



COMIC

Grip: The Strange World of Men, by Gilbert Hernandez

$2.50 PER ISSUE

Mike Chang and his skin lead separate lives. That's the setup for Gilbert Hernandez's latest comic feat, *Grip: The Strange World of Men*. From there, the miniseries follows the tragic hero's travels in a classic mélange of fantasy, noir, comedy, and sci-fi. The fifth and final issue is due out in March.

Issue one drops the reader into a contemporary city full of freaks, poseurs, and trigger-happy gangsters. After a series of confusing encounters, Chang and his skin part company. How and why this happens are unclear, but the last panel foreshadows what's to come: A gap-toothed little girl with an eye patch frolics with Chang's floppy epidermis, which is drawn in a cheery style.

In issue two, Chang wanders around gibbering like a raw-meat lunatic while his skin tries to escape the little girl, who's keeping it as a pet. It isn't until issue three – an extended flashback – that we learn anything that makes sense of the story. It turns out that, years before, a secret cult tried to breed its own messiah and produced Chang instead. The skin-shedding ability is a side effect of experiments performed on many pregnant women in the cult, including his mom. Though Chang's captors/worshipers tried to prevent him from leaving, he overcame their brainwashing by inducing his own amnesia.

A miniseries that really gets under your skin

Issue four returns to the present. Here, someone is telepathically summoning all of the oddballs and crooks that've crossed Chang's path to the now-ruined cult compound where he grew up.

No character is what he or she first appears. The sweet old lady from issue one turns out, in issue three, to be a male cult member who murdered his wife and hijacked her skin to assume her identity.

Is Hernandez saying perception is only skin deep? Hardly – his subtext has always been more enigmatic than that. Issue five will almost certainly answer some questions but raise even more. Don't sweat the loose ends – just enjoy a 20-year comic veteran at play in his own strange world. – *Maurice Martin*

Vertigo/DC Comics: *www.dccomics.com.*

README

ON THE BOOKSHELVES OF THE DIGERATI

Will Wright
Chief game designer for Maxis and creator of *The Sims* and *SimCity*

The Life of the Cosmos, **by Lee Smolin**

"I'm currently working on a universe simulation game and have been reading a lot on recent discoveries about our galaxy, stellar processes, and astrophysics. Most science books are camouflaged in technical jargon – they sound deadly boring and dry – but Smolin comes across more like Richard Dawkins or Carl Sagan, and he makes it all interesting in much the same way that we'll need to in the game."

Patrick Byrne
Founder and CEO of Overstock.com

A Conflict of Visions: Ideological Origins of Political Struggles, **by Thomas Sowell**

"This book poses the question, 'Why do people line up so consistently on opposite sides of the fence on certain issues?' Sowell argues that there must be different assumptions underlying the views of both camps. He outlines the central arguments of these worldviews, one an unconstrained vision of mankind (man can be perfected, information centralized, and society engineered) and the other a constrained vision (mankind is base, information is too costly to centralize, and outcomes cannot be engineered). From experience, I think that data is costly to centralize and conclude that we should focus on designing social processes, not outcomes."

– Chris Baker

Willie Nelson
The Great Divide (LOST HIGHWAY)

As he gets older, Willie Nelson gets stylistically restless. The country icon's last two releases were a volume of children's songs and a long-overdue blues project. Accordingly, the best tracks on his latest CD – a Santana-esque crossover with a host of pop tunes – show the bandana'd one perfecting a range of styles. An unlikely cover of Cyndi Lauper's "Time After Time" has merit, as does an even more odd collaboration, "Last Stand in Open Country" with Kid Rock. While most artists fear aging, Nelson proves wiser on the piercing "This Face," plainly stating, "I have this honesty that grows with time." Honesty in direct proportion to risk is a beautiful thing. – *Jon Caramanica*

Fila Brazillia
Jump Leads (TWENTY-THREE)

Since 1991, Steve Cobby and Dave McSherry – in their quest to "eliminate mediocrity" – have infused conventional, nonmusical elements into their quirky dance music. On *Jump Leads*, the duo is up to its usual antics, slapping playful song titles such as "The Green Green Grass of Homegrown" and "Motown Coppers" onto unwieldy grooves that could fuel a fun house. One glitch: The addition of singer Steve Edwards on several tracks lends a distracting polish. – *Stacy Osbaum*

Nine Inch Nails
And All That Could Have Been (NOTHING)

Considering how sculpted and studio-manipulated Nine Inch Nails' music is, you wouldn't think their songs work well live. But evidence to the contrary abounds on this impressive concert collection, which is also available on DVD and VHS. It not only sears through such classic industrial rants as "Head Like a Hole" and "Wish," but also manages to keep the layered, haunting beauty of songs like "Hurt" and "Closer" intact. – *Paul Semel*

And You Will Know Us by the Trail of Dead
Source Tags & Codes (INTERSCOPE)

This Austin act is appropriately named: The band is known more for destroying its instruments onstage than for its talent. With this major-label debut, though, listeners will discover that the group ravages genres as violently as it does its guitars. Songs like "Heart in the Hand of the Matter" make torture beautiful, as an orchestra of effects tumbles over lyrics about a passing storm, while "Source Tags & Codes" is a milder sonic gale, including strings and vocal harmonies in its lush fold. For such an abrasive band, Trail of Dead is immensely gifted, shaping its volatile emotions into complex songs. – *Jennifer Maerz*

Rory Block
I'm Every Woman (ROUNDER)

After a four-year recording hiatus, Block returns with an offering that fuses her well-known blues stylings with R&B and soul. Her intensity, which has characterized her take on country blues, is again evident: A passionate rendition of "Ain't No Grave Can Hold My Body Down" is a serious dose of righteousness, as is the electrified groove of "I Feel Like Breaking Up Somebody's Home." Block touches traditional gospel and gets into straight-up old school on "Ain't Nothin' Like the Real Thing," and covers the tune "Pretty Polly" with Kelly Joe Phelps. The capper – a rousing version of Hudie Ledbetter's "Rock Island Line" with Paul Rishell and Annie Raines. – *Philip Van Vleck*

Brendan Benson
Lapalco (STAR TIME INTERNATIONAL)

Imagine if Bobby Brady's voice hadn't cracked and burned during that TV talent show. After winning, he would have bought Mom and Dad that silver platter, grown up to front Guided by Voices, and injected a little of his bubblegum virtuosity into the DIY vein. He'd probably have sounded a whole lot like Brendan Benson. Benson tosses off sparse, Beatles-worthy guitar ditties like a musical Midas who just can't help himself. Run, don't walk: *Lapalco* is an unpretentious pop gem. – *Dwight Fenton*

Louie Austen
Only Tonight (KITTY-YO)

A midlife crisis inspired lounge-act veteran Louie Austen to discover techno; that search has culminated in *Only Tonight*, one of his most intriguing recent stylistic synergies. The sixtysomething Vienna native croons Rat Pack-influenced vocals about love and loss over sweet-as-bourbon house tracks, and even duets with potty mouth Peaches on the bizarre "Grab My Shaft!" Jarring juxtapositions do crop up, but Austen's grace smooths the edges like so many martinis. – *Eric Demby*

Thievery Corporation
Sounds From the Verve Hi-Fi (VERVE)

This Washington, DC, conglomerate has mastered the easy-listening ethos, pulling elements of classic bossa nova, samba, and exotica into its modern electronic mix. This compilation of songs – culled from Verve's diverse back catalog, which spans 50 years – displays a level of craftsmanship that seems to elude most current pop groups. Few TC contemporaries can boast the emotive power in Astrud Gilberto's steamy cover of "Light My Fire," Willie Bobo's romantic "Lisa," or the incomparable Sergio Mendes leading Brazil '66 in "Chove Chuva." Sultry sounds for jaded ears. – *Tamara Palmer*

GAME

Herdy Gerdy

$50

The object of *Herdy Gerdy* is to, well, herd. Despite this, the PS2 game is strangely addictive and absolutely gorgeous.

As Gerdy, you hone your shepherding skills by corralling fictional creatures toward various goals. This is not an easy job – there are more than 20 species, each with distinct behaviors. The aggressive Gromps, for example, might eat the chickenlike Dupes for lunch if you place them too close together. That's where the ecology of the game really comes into play.

Best farm sim ever

Once you get good enough, you can take on the evil Master Herder, who has put Gerdy's father under a sleeping spell. Beating the Master awakens him and ends the game.

The nonlinear nature of the task allows players to explore sprawling ecosystems alive with butterflies and hand-drawn shadows. The cinematic richness looks so much like cel animation, it succeeds as a playable cartoon. – *Scott Taves*

Eidos Interactive: *www.eidosinteractive.com.*

MOVIE

Teknolust

$9 PLUS POPCORN

If you forced Mary Shelley, Timothy Leary, Camille Paglia, and John Waters to collaborate on a film, you'd still fail to duplicate the witty and timely madness of *Teknolust*. The digital movie, directed by Bay Area filmmaker Lynn Hershman Leeson, premiered at the Sundance festival in January and will travel to screens across the country throughout the year.

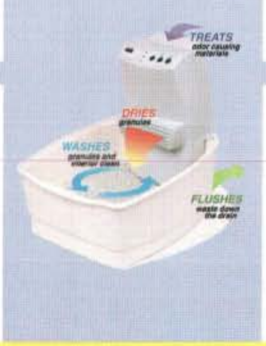
At *Teknolust*'s core is a modern retelling of *Frankenstein*. Hershman Leeson infuses her revisionist tale with a compelling gender twist and a playful sense of humor. Her scientist is the aptly named Rosetta Stone (Tilda Swinton), a gifted biogeneticist who plays God with her top-secret computer code. Rather than a hideous and numb-minded monster, Rosetta programs three smart and beautiful "self-replicating automatons" named Ruby, Marinne, and Olive (all also played by Swinton). The only flaw: The SRAs need sperm to survive. As a solution, Rosetta sends Ruby into the world every night to collect "donations" from men at local bars. Ruby runs into trouble when Federal Immune Patrol agent Edward Hopper (James Urbaniak) begins investigating a viral epidemic affecting the men who have had sex with her. When Rosetta is enlisted to aid in the police hunt, she must reconcile her growing attraction to Hopper with her desire to protect her digital daughter.

***Frankenstein*, with all-female parts**

Through the concurrent adventures of Ruby and Rosetta, Hershman Leeson explores postfeminist sexual reproduction, cloning, and Leary's vision of computer empowerment. So, while the film may not sound like your father's monster movie, it is thematically in sync with Shelley's observations from 1818. Fortunately, Waters-inspired mischief – such as Ruby trying to buy doughnuts with a handful of condoms, and the mysterious migrating Band-Aid on Agent Hopper's face – means the film doesn't take itself too seriously.

On the frontend, the feature was shot with Sony's CineAlta 24p digital camera, which delivers a picture comparable to traditional 35 mm as it runs at the native film rate of 24 progressive frames per second. The result is an astonishingly crisp picture, despite cameraman Hiro Narita's rejection of pure realism. Hershman Leeson's use of meticulous computer animation and innovative set design, including the virtual variety, add to the rich and novel production values. – *Tank Menzies*

Check for festival dates at *www.teknolustthemovie.com.*



HARDWARE

LitterFree

$300

I love animals, but I've never been into picking up after them. The LitterFree self-washing cat box is made for squeamish pet owners – and for pets like Ellie May, the cat I borrowed to test it out.

Like it sounds, the LitterFree is basically a mini-toilet – flushing waste and its accompanying odors away. The intake hose attaches to a bathroom sink's cold-water pipe and the outtake hose to a toilet. When I tried to attach the intake hose, neither the ¾-inch nor the ¼-inch adapter fit. One call to LitterFree and a new ½-inch fitting was at my door in days.

It was time to get the thing working. I filled the box with the special Styrofoam-like "litter" granules and – to get Ellie May's attention – moved some feces from her old box to this one. She poked her head in, but quickly headed for her old pooping grounds. By the next day, though, she was squatting in her new john.

Rather than program the unit to flush automatically, I pressed the manual button to activate it once Ellie May was out of the room (it's really loud, and I didn't want to spook her). Water poured in, swirling vigorously in the basin for a couple of minutes before being sucked out of the LitterFree and pumped into the toilet bowl (leaving behind the reusable granules). The cycle repeats twice more – using a lot of water – after which the kitty droppings were practically gone. Then, a fourth cycle runs a floral-scented liquid through the litter to banish any smell. A few minutes of blow-drying prepares the box for Ellie May's next visit.

Hands-free pooper-scooper

It's an awfully elaborate system for such a simple task, but it did the job I didn't want to do. – *Chris Rubin*

Pet-Centric: (866) 587 3733, *www.litterfree.com.*

WEB

Pixelsurgeon.com

FREE

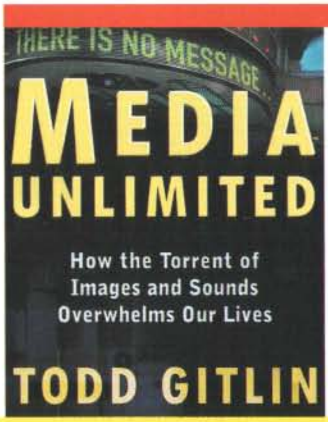
What makes Pixelsurgeon stand out among the profusion of portals geared to designers (K10K, Design is Kinky, and Surfstation, to name a few)? Humor. Yes – I laughed out loud at an irreverent splash page featuring Evil Genius' twisted medical illustrations. Click the "forum" button and you get a man squeezing his nipple and the words *coming soon*. Ouch.

Beyond giggles, the content hits home. Among the array of insightful interviews, reviews, and news clips, I read an eye-opening story on the best female designers working today. It's a piece that should've been done a long time ago, and introduced me to a dozen artists I'd never heard of. Extra bits such as downloadable custom icons, photos, and links ensure that you're never more than a click away from another new idea.

One-stop design shop

Digital designers should spend some time here – if not for the read, then for the cool, cheap fonts. – *Daniel Carter*

Pixelsurgeon: *www.pixelsurgeon.com.*



BOOK

Media Unlimited: How the Torrent of Images and Sounds Overwhelms Our Lives, by Todd Gitlin

$25

NYU professor Todd Gitlin winces when people refer to the media as a collective noun – "the media is" instead of "the media are." Nevertheless, he embraces the meaning conveyed by the reviled usage. His new book portrays the media as a monolithic and unavoidable element of the current human condition.

"The obvious but hard-to-grasp truth," Gitlin writes, "is that living with the media is today one of the main things humans beings do." We're living with unprovoked Flash animations and pop-up windows online, blaring soundtracks in retail stores, and scrolls, headlines, and subheads on cable news. As with molecules in the air, we're hardly aware of the individual elements – we're just breathing them in.

Why communication is killing us

What effect does it all have? Gitlin gives us a laundry list. The communications "deceive," "broadcast a limiting ideology," and "convey diminished images of the good, the true, and the normal." But the worst offense is that "they saturate our way of life with a promise of feeling." It's this vague, empty promise that has us hooked. As in our least fulfilling relationships, we want what we can't quite have or what isn't really there at all. "The torrent of images, sounds, and stories will widen," he writes, "but neither its volume, speed, nor bandwidth can be counted on to deepen democracy, or for [that] matter, the quality of feeling or commitment with which people conduct their lives." Our reality, in other words, is becoming largely just the look and feel of reality. And this, Gitlin convincingly if underwhelmingly argues, is unfortunate.

The author makes a point of contrasting his views with those of Marshall McLuhan, but the two are closer than he thinks. According to Gitlin, the experience of the media shapes our lives more than the actual content of this experience. For McLuhan – who in his day was primarily concerned with the effects of broadcast television – the medium, or mode of delivery, shapes our lives more than the message it delivers. Either way, content runs dead last.

But Gitlin takes the dimmer view. He offers no plan for changing a phenomenon that's hollowing out our emotional life. Perhaps that's because, at this point, the situation seems all-encompassing and impossible to alter. On the other hand, unlike "media" or "air," "people" isn't a singular term. Individuals have been known to ignore theories about their behavior and through their actions, to prove those theories wrong. – *John Glassie*

Henry Holt: *www.henryholt.com.*

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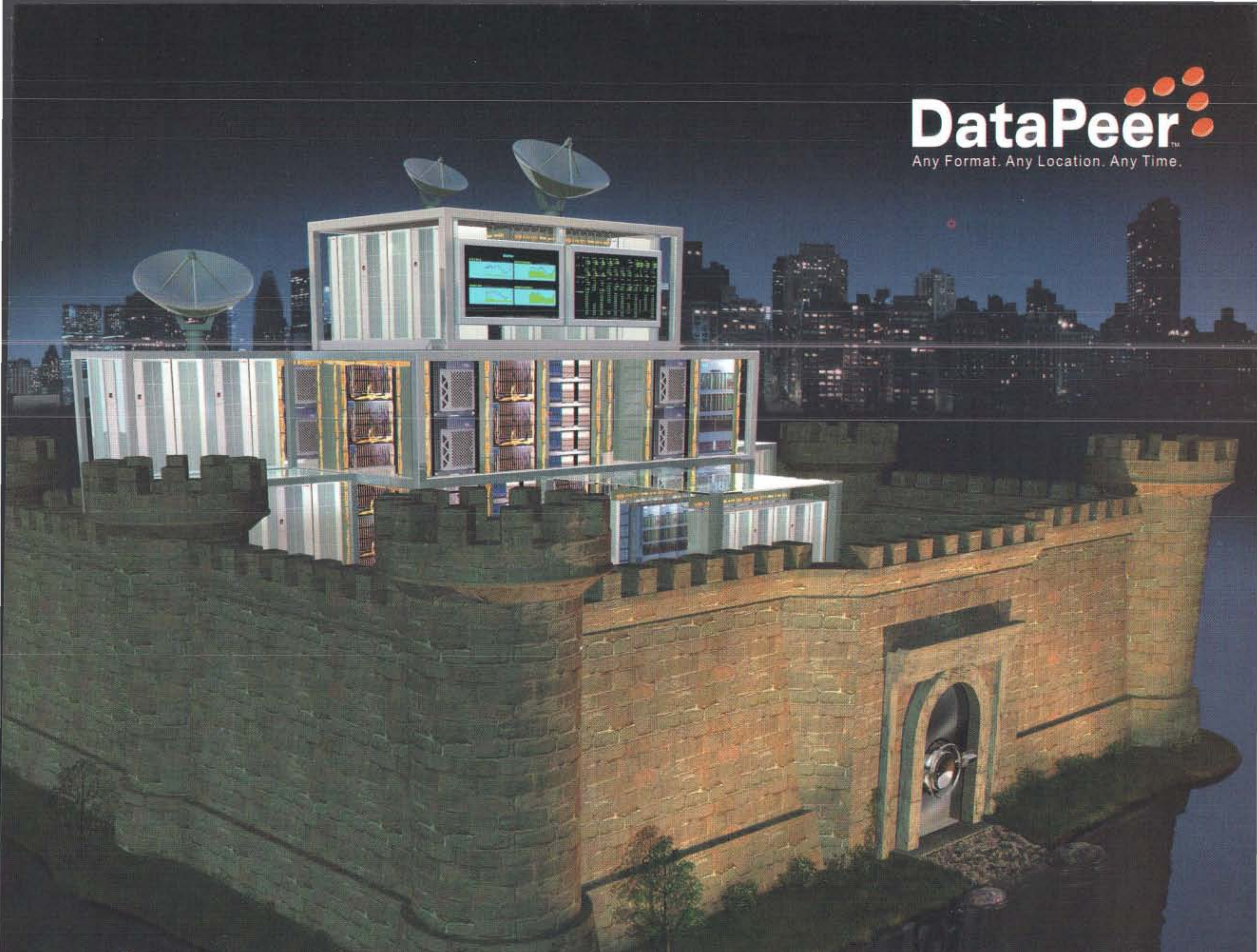

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Pedometers

The latest batch of step trackers does much more than record how far you go. The classier monitors also log your speed, your heart rate, and the calories you burn with 98-percent accuracy. And though the less precise analog model below appeals to traditionalists (Scouts still hook 'em to their belts for hikes), there's no reason athletes should settle for anything less than digital.

Fitness Pedometer 360

FIRST CLASS

FitSense FS-1 Pro

It's neither pretty nor cheap, but this wirelessly connected three-piece system – a wrist-mounted computer, a chest strap, and a sensor that clips onto your shoe – does it all. Obsessive runners can check their heart rate, keep pace, track distances, and count calories while in motion. The large watch lets you chart your stats on the desktop: Simply point it at the low-frequency radio receiver (included) that plugs into your PC's serial port, and beam over the data.
FS-1 Pro with NetLink and Heartstrap: $300.
FitSense: (800) 419 3667, *www.fitsense.com.*

BUSINESS CLASS

Nike SDM Triax 100

This watch-and-sensor combo works on the same principle as the FS-1: Attach the sensor to your shoe, and it delivers exercise data via RF signal to the watch in real time. Though the Triax loses a bit of its accuracy when the wearer switches strikes (say, from walking to running), it's a lot easier on the eyes. With its silver and yellow highlights, it's one of few sport watches you'll want to wear in between workouts.
SDM Triax 100: $235. Nike: (800) 344 6453, *www.nike.com.*

COACH

Sportline Fitness Pedometer 360

Characteristic of electronic pedometers, which monitor body motion to determine the distance traveled, the Sportline 360 works best when clipped to your waistband and kept completely vertical – not an easy task if you're keeping a brisk pace. Enter your weight and stride length, and the unit registers mileage and calories burned (with 90 percent accuracy). The display lets you scroll through the previous seven days of data and protects against accidental resets – features that set the 360 apart from others in its class.
Fitness Pedometer 360: $40. Sportline: *www.sportline.com.*

Video-Editing Workstations

Just because you *can* use your computer to edit digital video, doesn't mean you *should*. The average system tends to crash – a lot and at the worst moments. Standalone nonlinear video editors let you work uninterrupted and render your effects faster than similarly powered desktop systems. Any model should have processing might, ample storage, and flashy extras.

Casablanca Kron

FIRST CLASS

MacroSystem Casablanca Kron

Don't put your next video on Stone Age cassettes. The Kron is the only system that uses an optional internal DVD-RW burner for truly high res. Whether you add footage, build transitions, or lay-over titles, the system flies thanks to a custom OS and a 500-MHz AMD K6 processor. The box has a 40-Gbyte internal hard drive for nearly three hours of digital video. On top of that, it can work in the compressed MPEG-2 format, letting you store a day's worth of footage.
Casablanca Kron: $5,495; Pioneer A03 DVD-RW: $995.
MacroSystem: (877) 554 2846, *www.casablanca.tv.*

BUSINESS CLASS

Edirol DV-7

Edirol, a respected name in audio editing, pays as much attention to sound as it does to video: The RV-7 packs Roland technology for tweaking things like reverb and pitch. The editor relies on a multimedia-friendly version of the Be operating system and a proprietary processor. It also has USB and FireWire ports, a 60-Gbyte hard drive, and a CD-ROM for pulling in music tracks. For an extra $325, you can get Edirol's newsroom-style controller, which includes a jog dial, T-bar control, and audio sliders.
DV-7: $5,995. Edirol: (800) 380 2580, *www.edirol.com.*

COACH

Applied Magic ScreenPlay

ScreenPlay comes loaded with more than 100 visual shifts and special effects (like slow motion and solarized color). Best of all, the simple, intuitive interface lets you actually find and use them all. The 60-Gbyte drive has space for up to four and a half hours of broadcast-quality video, and the Power PC processor and custom operating system are zippy. Use the CD-ROM to import TrueType fonts, soundtracks, and still images for creating fully loaded flicks.
ScreenPlay: $3,995. Applied Magic: (888) 624 4255, *www.applied-magic.com.*

Digital Cordless Phones

Sure, the cellular revolution has overshadowed the advances in the cordless phones. But the days of staticky conversations are over, thanks to spread spectrum digital technology. Like the latest cells, the new cordless models offer greater range, sound quality, and security. They also have more features, such as remote-control capabilities and built-in answering machines.

Gigaset 4215

FIRST CLASS

Bang & Olufsen BeoCom 6000

This angular 2.4-GHz phone offers phenomenal sound quality that's rarely interrupted when used within range (164 feet from its base indoors, 984 feet outdoors). It can handle six additional handsets, which double as remotes for B&O stereos and TVs. Input new info into one, and the rest sync up. The dial lets you scroll through your programmed numbers. The only bummer: B&O's digital answering machine is sold separately – a minor inconvenience for a sexy phone.
BeoCom 6000: $475. BeoTalk 1200 answering machine: $195.
Bang & Olufsen: +1 (847) 590 4900, *www.bang-olufsen.com.*

BUSINESS CLASS

Siemens Gigaset 4215

With its sleek design and sophisticated display, the Gigaset 4215 looks more like a cell than a cordless handset. Perfect for big backyards or neighborhood strolls, the 2.4-GHz phone roams as far as the BeoCom does, but one-ups it with a built-in digital answering machine capable of storing 33 minutes of messages. The system works with four handsets and learns four users' voices for hands-free dialing. Like the BeoCom, this baby can stash 200 names and numbers in its directory.
Gigaset 4215: $230. Siemens: (888) 777 0211, *www.icm.siemens.com.*

COACH

Audiovox DT951 Ci

Operating at 900 MHz doesn't mean you have to sacrifice sound quality. With this phone, you can make your point – clearly – from up to 500 feet away. The battery allows seven hours of talk and a week of standby time, similar to the pricier models. The answering machine has only 15 minutes of storage, but there are three mailboxes. The caller ID holds 50 numbers, a quarter of what the others do, but who're you kidding – do you really expect more than 50 callers?
DT951 Ci: $130. Audiovox: (800) 229 1235, *www.audiovox.com.*

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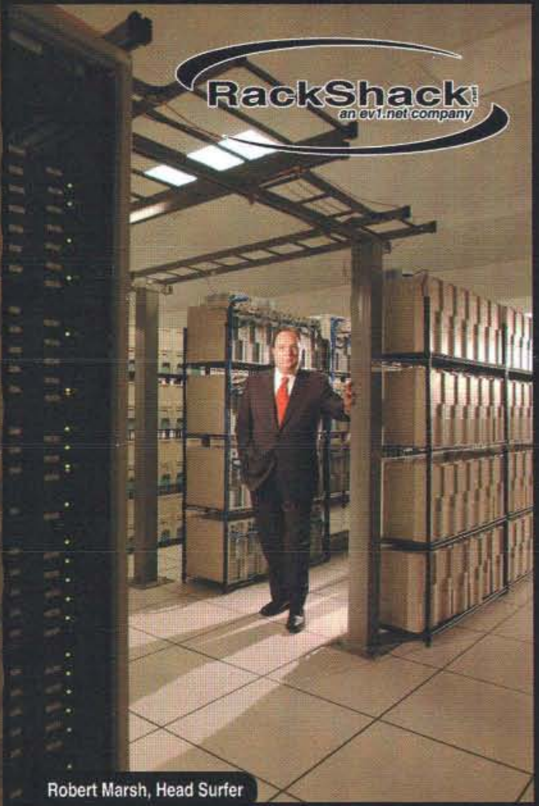

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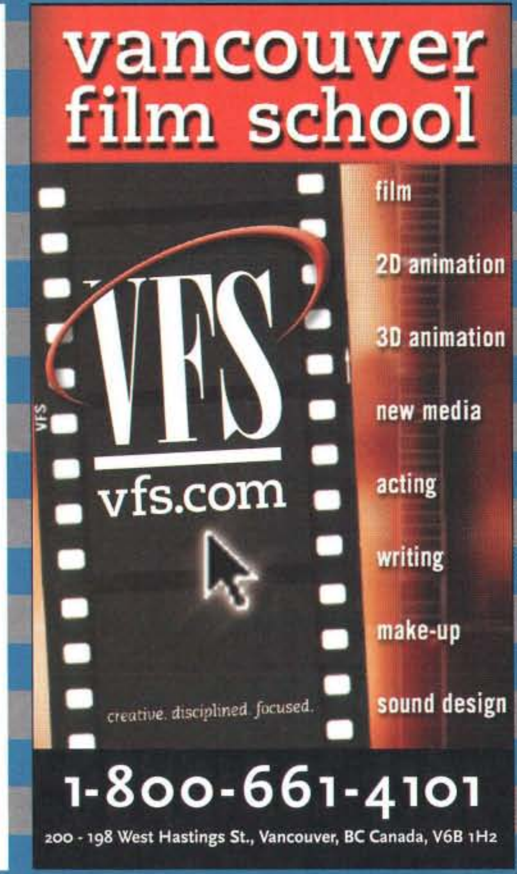

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"RETURN TO SENDER"

The Wired "Return to Sender" Contest Official Rules

(See page 19.)

NO PURCHASE NECESSARY TO ENTER TO WIN

The Wired "Return to Sender" Contest is sponsored by *Wired*, 520 Third Street, 3rd Floor, San Francisco, CA 94107-1815 ("sponsor").

Eligibility: Contest is open to residents of the United States and Canada (excluding Quebec), except employees of *Wired*. Enter by sending in your postal art (any mailable object) for consideration, along with your name, address, email address (if any), and telephone number, to:

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Entries for the June issue must be received no later than March 1. One winner will be chosen based on the most unusual entry on or about March 11. One entry per person permitted. All entries become the property of the sponsor and will not be acknowledged or returned. All decisions by the judges are final. Grand prize: one (1) *Wired* T-shirt (approximate retail value $30). Void in Puerto Rico, the Canadian province of Quebec, and where prohibited. If the winner is a resident of Canada, the winner may be required to correctly answer a time-limited arithmetical skill-testing question. Subject to all federal, state, local, and provincial laws and regulations. Income and other taxes, if any, are the sole responsibility of the winner.

For the name of the grand-prize winner, send a self-addressed, stamped envelope to Wired "Return to Sender" Contest Winner (June), 520 Third Street, 3rd Floor, San Francisco, CA 94107-1815, after March 11.

Acceptance of the grand prize constitutes consent to use the winner's name and likeness for editorial, advertising, and publicity purposes without further compensation (except where prohibited by law).

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HOW TO PLAY. Look for a potential winning game piece inside specially marked regular tins of Altoids Peppermint, Cinnamon or Wintergreen flavors. If you find a regular tin that contains a potential winning game piece, you win the prize indicated, subject to verification. Non-winning specially marked regular tins WILL NOT CONTAIN a game piece or notice of any kind inside.

PRIZE CLAIMS. Sign your potential winning game piece, and type or print the following information on a 3"x 5" card/paper: your full name, complete address with ZIP Code, date of birth, and day/evening phone numbers with area codes, and mail along with the potential winning game piece in a business size (#10) envelope to: Altoids Muscle Car Game, P.O. Box 27172, Golden Valley, MN 55427-0172. Prize claim must be mailed via certified mail (return receipt requested) and must include original potential winning game piece. Retain a photocopy of your game piece for your records. All prize claims must be received by June 30, 2003. Upon verification, winners will be notified by mail.

ALTERNATE METHOD OF PARTICIPATION. To participate without purchase, hand print your full name, complete address with ZIP Code, date of birth, and day/evening phone numbers, with area codes, on a 3"x 5" card/paper, insert into a business size (#10) envelope and mail to: Altoids Muscle Car Game — Game Play Request, P.O. Box 3311, Maple Plain, MN 55593-3311, to be received by June 30, 2003. One game play per request; one request per outer mailing envelope. No mechanical reproductions or photocopies of requests will be accepted. The independent judging organization will play for you and notify you by mail ONLY if you are a potential winner.

PRIZES/APPROXIMATE RETAIL VALUE (ARV)/ODDS OF WINNING. Three (3) Prizes: A choice of (a) a check in the amount of $40,000 OR (b) a "muscle car." In the event winner chooses a muscle car, Sponsor shall purchase a previously owned automobile, after consultation with winner, up to a maximum Purchase Price of $40,000. "Purchase Price" includes cost of the car, plus sales tax, licensing and registration fees, and, if applicable, delivery charges from dealership to winner's place of residence. Prize will be awarded "as is" and winner agrees to look solely to manufacturer or dealership with respect to any warranties and guarantees related to the "muscle car" prize. ARV: $40,000 each. Odds of winning: 1:3,333,934. Total ARV of all prizes: $120,000. Unclaimed prizes will not be awarded.

CONDITIONS ON PRIZES. Potential winners will be required to execute and return an Affidavit of Eligibility, Release of Liability and a Publicity Release, where legal, within 14 days of date of congratulatory letter. Failure to return all executed documents within the allotted time may result in disqualification and prize forfeiture. All taxes on prizes are solely the responsibility of prizewinners. Acceptance of prize offered constitutes permission to use winner's name and/or likeness for advertising/trade purposes without further compensation, unless prohibited by law. Prizes will be awarded within 8–10 weeks after verification of prize claim. No substitution of prize permitted, unless prize is generally unavailable, in which case a prize of equal or greater value will be substituted, at discretion of Sponsor.

VERIFICATION. All game pieces are subject to verification. Game pieces are void and will be rejected if not obtained through authorized, legitimate channels or if any part is illegible, mutilated, altered, counterfeited or tampered with in any way, or if materials contain printing, production, typographical, mechanical or other errors.
If because of error (or for any other reason) there are more prize claims than prizes offered as stated in these Official Rules, a random drawing will be held from among all eligible claimants to award only the number of prizes as stated in these Official Rules. In no event will Sponsor be liable for more than the stated number of prizes in these Official Rules. Any attempt to defraud Sponsor or the official judging agency in any way will be prosecuted to the fullest extent of the law and person(s) attempting same will be disqualified and ineligible for prizes.

ELIGIBILITY. The following categories of persons are not eligible to participate or win: employees of Sponsor, its advertising and promotion agencies and their respective parent companies, affiliates, subsidiaries, sales representatives or distributors and persons who are members of the immediate family or who reside in the same household as persons in any of the above categories.

CONDITIONS OF PARTICIPATION. By participating, participants agree to abide by and be bound by the Official Rules and all decisions of the judges, which are final and binding in all respects. Submission of game materials including but not limited to prize claims is solely the responsibility of the participant. Sponsor and its agencies are not responsible for late, lost, misdirected, damaged, illegible, delayed, destroyed, incomplete or postage-due mail, game play requests or prize claims. All game materials submitted become the sole property of the Sponsor and will not be returned. Winning game pieces and/or prizes may not be assigned or transferred prior to award. In the event of non-compliance with the requirements set forth in these Official Rules, prize may be forfeited. Limit 1 prize per individual, family or household.

WAIVER. By entering this promotion, participant waives all rights to claim punitive, incidental and consequential damages, attorneys' fees or any damages other than actual out-of-pocket costs incurred to enter.

WINNERS LIST. For a list of winners, send a self-addressed, stamped envelope to: Altoids Muscle Car Game — Winners List, P.O. Box 3312W, Maple Plain, MN 55593-3312. Sponsor: Kraft Foods North America, Inc., Northfield, IL 60093.

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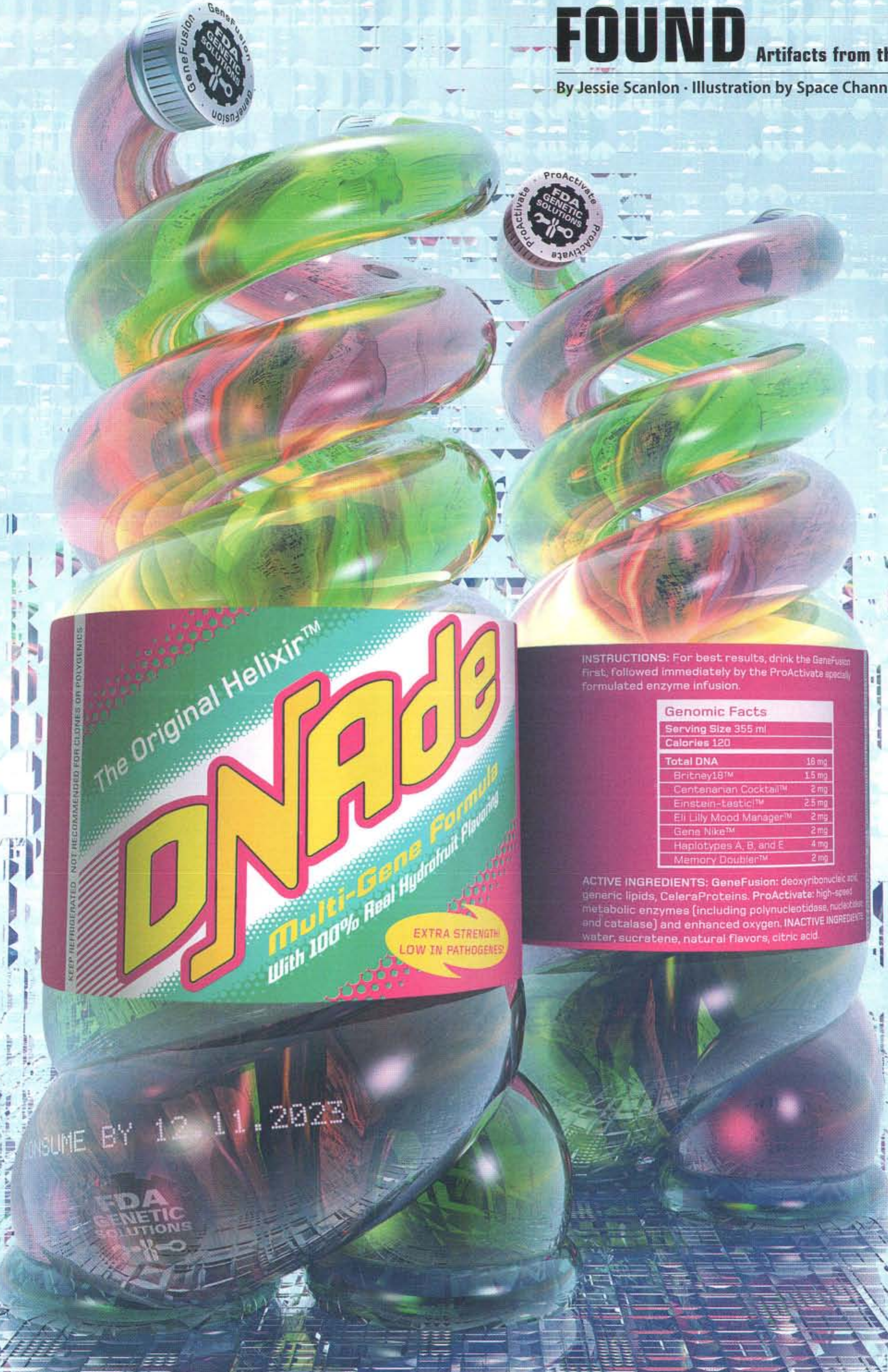
By Jessie Scanlon · Illustration by Space Channel



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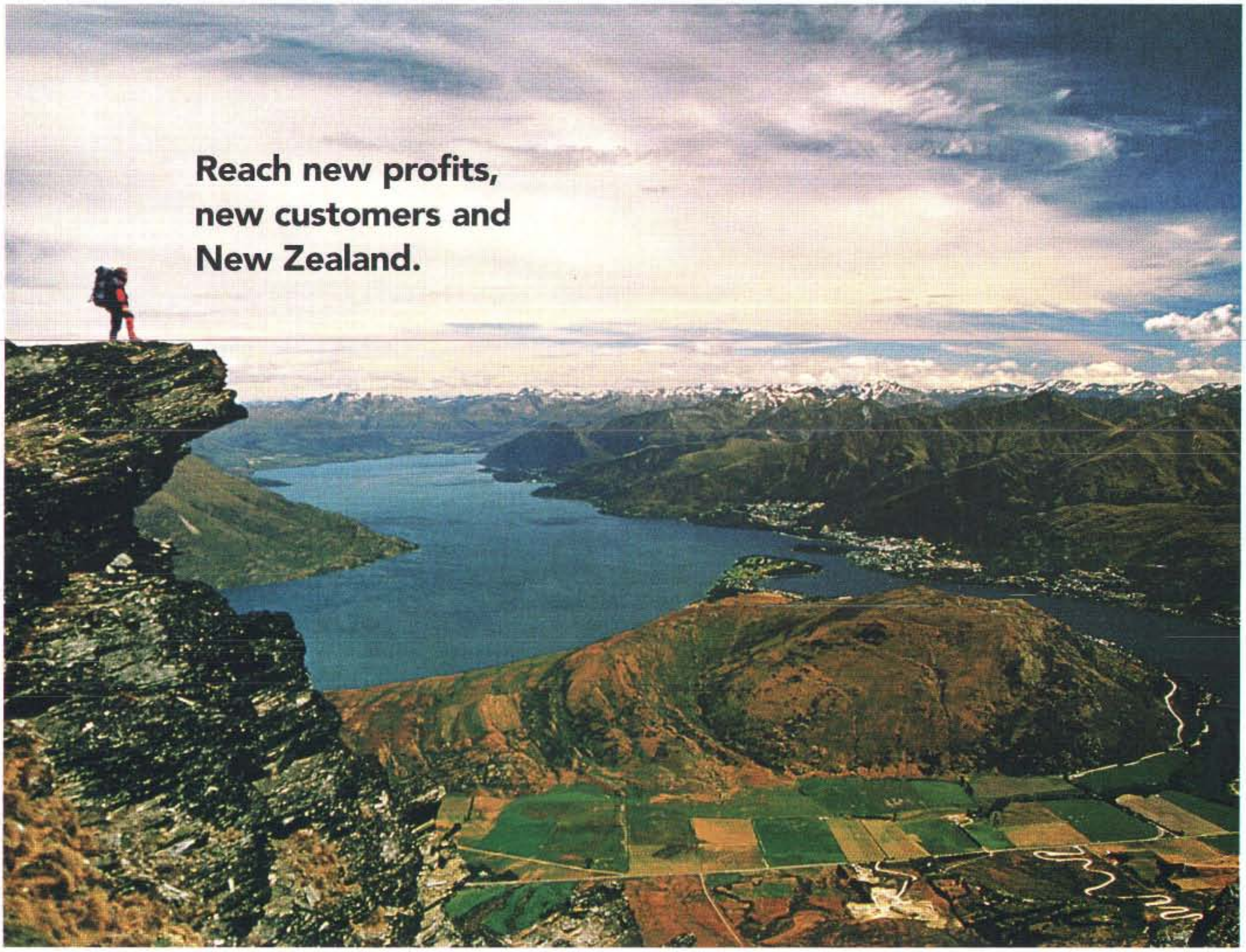

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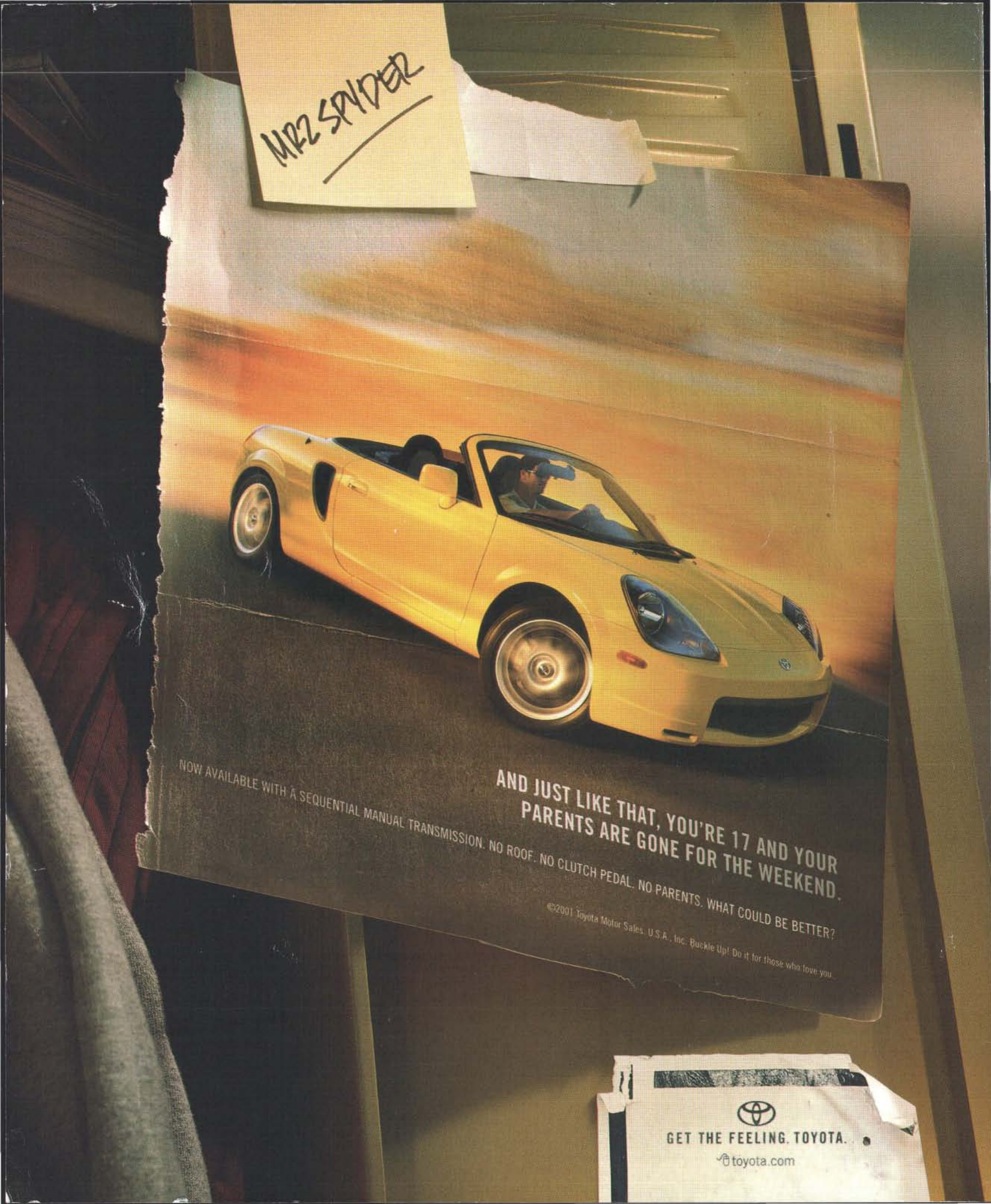
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